AD-A173 777 SPILLWAY MODIFICATION GRAPEVINE LAKE TEXAS(U) ARMY ENGINEER DISTRICT FORT WORTH TX A J MARR JUN 86 1/2

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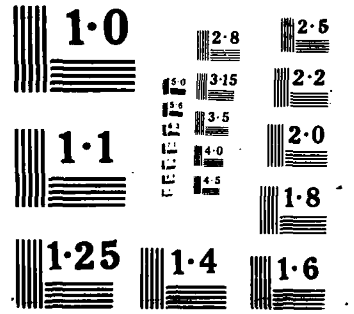
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US Army Corps
of Engineers
Fort Worth District

FINAL FOUNDATION REPORT

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SPILLWAY MODIFICATION
GRAPEVINE LAKE, TEXAS

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CORPS OF ENGINEERS
FORT WORTH DISTRICT, TEXAS

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GRAPEVINE LAKE
SPILLWAY MODIFICATION

BY

ALAN J. MARR
ENGINEERING GEOLOGY SECTION

JUNE, 1986

PREFACE

This report was prepared by Fort Worth District Staff Geologist, Alan J. Marr, under the supervision of the Chief of the Engineering Geology Section, Robert C. Behm, and the Chief of the Geotechnical Branch, Melvin G. Green.

District Engineers for the Fort Worth District during construction of the Grapevine Spillway were Colonel Theodore Stroupe and Colonel A. J. Genetti, Jr. Mr. Shigeru Fujiwara was Chief of the Engineering Division and Mr. William Niese, Jr. served as Resident Engineer during construction.

TABLE OF CONTENTS

TABLE OF CONTENTS

ILLUSTRATIONS (Continued)

I - INTRODUCTION

1. <u>Project Location and Description</u>. Grapevine Dam is located in Tarrant County, Texas, about 20 miles northwest of Dallas, Texas, on Denton Creek about 11.7 river miles above its confluence with the Elm Fork of the Trinity River. The location of the project is shown on Plate 1.

The Grapevine Lake project consists of a compacted earth-fill embankment, an uncontrolled, off-channel, chute-type concrete spillway, and a cut-and-cover conduit outlet. The embankment is 12,850 feet long and has a maximum crest width of 28 feet. Top of dam elevation is 588 NGVD which is 137 feet above the streambed. The 500-foot wide spillway has a crest elevation of 560 NGVD and is located in a natural saddle near the [illegible] abutment of the dam. The 13-foot diameter outlet conduit, located near the left end of the dam, is controlled by two 6.5- by 13-foot electrically operated sluice gates. A site plan of the project is shown on Plate 2.

2. <u>Construction Authority</u>. Congressional authority for the construction of Grapevine Lake and subsequent spillway modification is contained in the River and Harbor Act approved March 2, 1945 (Public Law 14, 79th Congress 1st Session), in accordance with the recommendations of the Chief of Engineers contained in House Document No. 403 (77th Congress, 1st Session). Public Law 79-14 authorizes the U.S. Army Corps of Engineers to construct, repair, and preserve certain water resources projects in the Trinity River Basin, including Grapevine Dam and Lake.

3. Purpose of Report. This report has been prepared in accordance with requirements as set forth by the Office, Chief of Engineers, in ER 1110-1-1801. This report provides a complete record of foundation conditions encountered during construction of spillway modifications at Grapevine Lake. Information contained in this report will be valuable when evaluating: (1) necessary remedial action required to prevent or repair any failures resulting from foundation deficiencies; (2) Contractor claims related to foundation conditions or alleged change of conditions; and (3) planning and design of future comparable construction project.

A copy of this report will be included in the permanent records maintained at the project office.

4. Project History. Construction of Grapevine Dam began in January 1948 and was completed in June 1952. During heavy rains in May 1957 the reservoir level reached conservation pool, elevation 535, for the first time and eventually peaked at elevation 560.8 which was 0.8 feet above the spillway crest. Flow through the spillway washed out FM 2499 and caused minor erosion damage in the spillway channel, all of which was repaired.

Again during October and November 1981, the spillway went into service for 21 days. The reservoir elevation peaked at elevation 563.29, or 3.29 feet above the spillway crest. Discharge through the spillway, shown in Figure 1, peaked at 9100 cfs flowing at a velocity of 30-40 feet per second. The heavy discharge caused severe erosion

Fig. 1 - Flow through the Grapevine Spillway in November 1981

in the unprotected discharge channel, as seen in Figure 2. The erosion cut reached a maximum depth of about 30 feet below the original channel floor at a point about 600 feet downstream from the end of the existing concrete spillway apron slab.

The severity of the erosion damage created concern that another overflow event could undermine the concrete spillway chute and weir and ultimately endanger the integrity of the entire structure. As a result the Fort Worth District conducted a study of the project which resulted in the following recommendations:

(a) The spillway should be modified to include an elongated concrete chute that terminated into a stilling basin.

(b) The downstream face of the embankment which has been periodically subjected to erosion and sloughing, would be stabilized by constructing a berm using soils excavated for the spillway modification.

(c) FM 2499 would be relocated to cross the existing spillway apron.

The Southwestern Division Office and the Office of the Chief of Engineers approved the recommendations and requested that a design memorandum detailing the proposed work be prepared. Design Memorandum No. 3 - Modification of Embankment and Spillway was published in June 1983 followed by the project plans and specifications in August 1983. The contract was awarded and construction began in November 1983 with a scheduled completion date of June 1985.

Fig. 2 - Damage resulting from the November 1981 flood

5. <u>Modification of the Spillway</u>. The existing spillway was cut in a relatively narrow saddle about 1500 feet left (northwest) of the left abutment of the dam. If consists of a 500-foot wide by 400-foot long approach channel cut in natural ground to approximate elevation 550, a 500-foot wide concrete ogee weir with a crest elevation of 560.0 connected to a 200-foot long concrete apron sloping at a 5 percent grade, and a 500-foot wide discharge channel cut in natural ground and terminating in a natural ravine about 900 feet from the end of the apron. A plan of the existing spillway is shown on Plate 4.

The spillway modification consisted of constructing a reinforced concrete chute and stilling basin immediately downstream of the existing spillway apron. The chute is 500 feet wide by 301 feet long and provides a transition from elevation 540.0 to the new stilling basin elevation 462.0 The stilling basin is 130 feet long and bordered on each side by 33-foot high vertical concrete walls. For a distance of 265 feet from the end of the stilling basin the 510-foot wide downstream channel is graded to elevation 465 and protected by rip-rap. The channel then slopes upward on a 1 vertical on 10 horizontal grade to intersection with natural ground.

6. <u>The Contract</u>. Pertinent information related to the contract is listed below:

Modification of Embankment and Spillway - Grapevine Lake

Contractor: Granite Construction Company, Watsonville, CA

Contract No.: DACW63-83-C-0160

Bid: $9,561,342.50

Contract Award Date: 30 Sep 83

Notice to Proceed: 26 Oct 83

Work Completed: November 1985

Contractor Superintendent at Site: Edouard (Skip) Izac

7. Quality Control. Quality control for all phases of the contract was furnished by the Contractor. Mr. John Moran performed all quality control functions from the beginning of the work until 3 Jan 85. During the remainder of the contract quality control functions were performed by Mr. Ron Milan.

8. Contract Supervision. Work under this contract was performed under the immediate supervision of the District Engineer, U.S. Army Engineer District, Fort Worth, Texas. The Contracting Officer's representative for adminstration of the contract was Mr. James D. Leslie, Area Engineer, North Texas Area Office. Mr. Bill Niese served as Resident Engineer during construction.

II FOUNDATION EXPLORATIONS

1. Investigations Prior to Construction of the Existing Spillway. Geological investigations were conducted at the Grapevine Dam site as early as 1924. Much of the data collected during design and construction of the project, including original core boring logs and laboratory test results, are no longer available. A summary of some of this early data is found in the Definite Project Report, dated July 1947, which is available in SWFED-F.

2. Investigations Prior to Modification of the Spillway. Investigations for rehabilitation of the Grapevine Spillway began in December 1981, 2 months after the overtopping event. A total of 10 combination auger, fishtail, rock-bit and core borings were drilled to develop subsurface information. The borings included 302 linear feet of 4- and 6-inch core samples and 688 linear feet of auger, fish-tail and rock-bit borings. Electric logs were run in all but one of the borings to aid in stratigraphic correlation. Three bail-down/recovery tests were performed in selected borings in order to determine general ground-water conditions at the site. Locations of the borings and sections are shown on Plate 4. A centerline profile is shown on Plate 5, and Section B-B, C-C, and D-D are presented on Plates 6, 7, and 8 respectively. Results of all investigations were presented in Design Memorandum No. 3 - Modification of Embankment and Spillway - Grapevine Lake, published in June 1983.

3. Investigations During Construction. No unanticipated foundation conditions or problems were encountered during construction that required additional subsurface investigations.

III GEOLOGY

1. Physiography and Regional Geology. Grapevine Dam and spillway are located within the Eastern Cross Timbers Section of the West Gulf Coastal Plain physiographic province. The Eastern Cross Timbers Section occurs as a relatively narrow belt of moderately rugged topography which trends north-south through the area generally reflecting the outcrop of the basal member of the Woodbine Formation of Upper Cretaceous Age. Regional dip of the strata is toward the southeast at a steeper slope than that of the land surface resulting in older strata being encountered as one travels northwest upstream from the dam. In the project area the Woodbine Formation reaches an estimated thickness of 320 feet and consists of an alternating series of sands, clays, shales, and weakly indurated sandstones. The areal geology map is presented on Plate 3.

2. Geology of the Spillway.

(a) Description of the Overburden. Overburden in the vicinity of the Grapevine spillway consists of a thin mantle of residual soils resulting from the weathering of the sands and shales of the upper portion of the Woodbine Formation. Overburden exposed in the excavation slopes consists of fine-to-medium grained, loose to medium dense sand with varying amounts of silt, clay and gravel.

(b) Bedrock Stratigraphy and Lithology. The Grapevine Spillway is founded within strata of the Woodbine Formation. Borings within

the limits of the existing spillway encountered a 5-foot thick layer of reddish-brown, massive, fine-grained, weakly cemented sandstone which served as the spillway floor immediately downstream from the concrete apron. Underlying the sandstone layer was approximately 40 feet of soft, often carbonaceous, dark gray to brown, massive-bedded, sandy shale with occasional thin interbeds of glauconitic sandstone. Lignitic seams were noted along some of the bedding planes. Below the shale section is a sequence of alternating soft to moderately hard, fine-grained, weakly to moderately cemented, thin-bedded sandstones and soft, sandy shales which continue down to and below the base of the excavation. An increasing percentage of sandy material and the occasional occurrence of thin, moderately hard to very hard, very fine-grained sandstone and siltstone layers were observed as the excavation deepened.

Gradational changes in the lithologic composition of the Woodbine strata are typically pronounced, often changing from sandy shale to shaly sand or sandstone within a few feet. The lithology shown on the geologic map (Plate 9), generally classifies the materials according to their dominant composition. See Plates 5 through 8 for geologic profile and sections.

(c) Bedrock Structure. The Woodbine strata in the spillway area dip toward the southeast at a rate of about 100 feet per mile. No major faulting or folding was observed within the spillway excavation limits. Some minor jointing and fracturing was observed during the course of the excavation down to elevation 495; below this elevation

the strata was essentially free of structural discontinuities. Individual layers of competent material were sometimes separated by bedding planes of weaker material, often resulting in some minor overexcavation in areas where finished grade occurred within the more competent layers.

(d) Weathering. Weathering of strata within the Woodbine Formation is generally recognized by the change in color of the materials from gray when unweathered to light brown or yellow when weathered. This weathering reaction is caused by oxidation of the iron within the highly ferruginous formation. Shales are generally altered to the consistency of stiff clay, while sandstones tend to become indurated, as was the case with the 5-foot thick sandstone layer exposed on the spillway floor. Since the sandstone on the floor of the spillway had only been exposed to the weathering processes for the period since original construction in 1952, weathering was apparent only within 3 to 5 feet of the surface. In the slopes of the spillway excavation, the thickness of the weathered zone was generally from 10 to 15 feet. The spillway was founded entirely within unweathered strata.

(e) Ground Water. Ground water encountered during the course of the spillway excavation was minor and was adequately controlled using collector ditches and sump pumps. Minor amounts of ground water leaked out of the overburden on the upper slopes of the excavation. The amount of seepage and number of seepage areas varied according to the amount of rainfall. During dry periods there were only 3 seepage areas which continued to produce water. The 3 areas are shown on Plate 9.

Individual seepage points in the Woodbine Formation strata beneath the spillway structure were rarely detected during the course of the excavation because of the small amount of flow and the short time period that the surface was exposed. However, as the excavation progressed downward through the increasingly sandy Woodbine strata, reaching the base of the 1 vertical on 3.5 horizontal slope, water exiting from the sand filter blanket gave evidence of the collective seepage emitting from the foundation strata. The amount of seepage from any one area along the filter blanket generally amounted to only a few gallons per minute, only slightly hindering the cleaning of the freshly excavated surfaces downslope from the filter blanket.

After the excavation reached the stilling basin level the Contractor installed a collector well with collector ditches to care for both surface water and ground water entering the excavation. The location of the collector well is shown on Plate 9. Details of the collector well are described in Dewatering Provisions, Section V-2 of this report.

3. <u>Engineering Characteristics of the Overburden Materials</u>. All foundation investigation borings were located within the limits of the existing spillway where the overburden had been removed during original construction. As a result, no overburden samples were collected during the investigations for laboratory testing. Based on original project design values, the following design parameters were adopted by the Geotechnical Branch, Soils Design and Dam Safety Sections for the overburden materials:

Unit Weight	**R - strength**
moist - 125 pcf	c - 0.5 tsf
saturated - 130 pcf	0 - 16 degrees
Q - strength	**S - strength**
c - 1.0 tsf	c - 0.1 tsf
0 - 5 degrees	0 - 20 degrees

Overburden materials located outside the limits of the existing spillway, but within the limits of the new spillway excavation were used as select fill in constructing a berm on the downstream face of the main embankment under this contract.

4. <u>Engineering Characteristics of the Primary Materials</u>. Laboratory testing of primary materials was performed on core samples obtained from borings 8A6C-602 and 8A6C-603. A summary of the test results is presented on Plates 15 thru 17.

The results of laboratory testing indicate a slight variation in the strength and character of the Woodbine materials with depth. Therefore, the following design parameters were adopted for the primary materials:

Upper Primary Materials

Unit Weight	**R - strength**
moist - 135 pcf	c - 0.2 tsf
saturated - 140 pcf	0 - 30 degrees
Q - strength	**S - strength**
c - 0.7 tsf	c - 0 tsf
0 - 25 degrees	0 - 30 degrees

Lower Primary Materials

Unit Weight	R - strength
moist - 140 pcf	c - 0.2 tsf
saturated - 145 pcf	0 - 30 degrees
Q - strength	**S - strength**
c - 0.7 tsf	c - 0.2 tsf
0 - 25 degrees	0 - 30 degrees

5. Unusual or Unanticipated Conditions. There were no unusual or unanticipated conditions encountered that adversely affected the construction of the Grapevine Spillway.

The discovery of an isolated ± 1-foot thick limestone layer approximately 220 feet left of centerline station 14 + 20 was unexpected. (limestone was not observed in any of the samples retreived during subsurface investigations). The presence of limestone is unusual, though not unprecedented within the Woodbine Formation. The occurrence of the limestone did not affect the excavation phase of the project, but it was the basis of a claim by the Contractor citing the extra time required to drill rock anchor holes.

IV SPECIAL DESIGN CONSIDERATIONS

1. During design of the spillway special consideration was given to the fact that the spillway is an active spillway for an existing reservoir with the possibility of engagement during the period of construction. Operation of the spillway during construction could have results ranging from lost construction time to catastrophic loss of the entire spillway. Although this fact did not alter the design of the spillway, special precautions were undertaken during construction to reduce the risk of spillway engagement and resulting damage. These precautions include the following:

(a) Sandbags were placed on the existing spillway weir raising the spillway crest from 560.0 to 562.5, thus increasing the computed spillway operation frequency from 100 years to approximately 270 years.

(b) A lower reservoir elevation was maintained during construction through the cooperation of local water supply users who responded to a letter request by CE to increase their water usage from Grapevine Lake when the reservoir elevation was above elevation 528 NGVD (about 75 percent of normal conservation pool).

(c) And finally, the amount of unprotected excavated surface was kept to a minimum by requiring the excavation and concrete placement to be staged into coordinated phases of work so that concrete placement would closely follow the deepening excavated surface.

2. Due to the proximity of the existing reservoir to the proposed spillway excavation, special consideration was given to ground water

during design of the project. There was early concern that the Woodbine Formation, which often has the capability of transporting and producing significant amounts of ground water, could transmit water to the excavation directly from the reservoir. However, the results of investigations in the spillway area indicated that the permeabilities of the Woodbine Formation sands were very low and that any ground water entering into the excavation could be controlled by a system of ditches and sump pumps.

V EXCAVATION PROCEDURES

1. Excavation Grades. Actual foundation conditions encountered during excavation for the rehabilitation of the Grapevine Spillway were essentially as described in the subsurface data presented in the contract plans and specifications. The design slopes in the overburden and primary materials were achieved and maintained generally without difficulty. Minor concerns which developed in the excavation slopes during construction were the low resistance of the material in the overburden slopes to erosion, and one minor slide which occurred in a vertically excavated shale face. Some minor variations (over-excavation) from the designed grade lines occurred. Final cross-sections on the excavation slopes were taken by the Contractor's survey team. The CE geologist, assisted by the Contractor's survey team, made all measurements of final excavation grade and recorded the foundation conditions below the new spillway structure. Final excavation grades below the spillway structure are shown on Plate 10. As-built centerline geologic profile and geologic section are presented on Plate 11 and Plate 12 respectively.

2. Dewatering Provisions. No serious ground-water problems were encountered in the spillway excavation. Perched water flow from the overburden slopes was the primary source of ground water within the excavation. Seepage from the exposed Woodbine strata in the excavation slopes was very minor, usually drying up before reaching the base of the slope. Ground water flowing from the excavation slopes was

controlled using collector ditches and sump pumps. The locations of ground water exit points are shown on the As-Built Geologic Maps on Plates 9 and 10.

For the most part the excavation of materials and the subsequent backfill of filter sand beneath the structure took place in the dry. Only an occasional small seep of water was observed in the Woodbine strata underlying the spillway structure during the brief periods between excavation and backfill that the surface was exposed. As the excavation approached the base of the 1V on 3.5H slope beneath the structure the accumulative water produced by the seeps became noticeable. Seepage water draining from the sand filter blanket trickled downslope and hindered the cleaning of the exposed sections of the foundation.

Surface water, i.e. run-off from rain, was a more difficult problem. The relatively large drainage area of the excavation combined with the highly erosive character of the excavation slopes caused heavy siltation in the work area even after moderate rains. Considerable construction time was lost while the work area, which normally was near the lower part of the excavation, was unwatered and cleaned of silt.

The Contractor installed a collector well in the base of the excavation as it neared final grade. A system of collector ditches intercepted the surface run-off and channeled it to the collector well for removal. The location of the collector well is shown on Plate 9. The well was equipped with a 6-inch 58 hp Flyght pump capable of pumping

800 gallons of water per minute from the well location to the edge of the excavation (aproximately 60 ft head). However, it was estimated that, with the heavy silt load, the actual pumping rate was about 400 to 500 gallons per minute. During dry periods the pump was operated intermittently - once every two to three days - to handle "nuisance water" exiting from the sand blanket. A 6-inch diesel pump supplemented pumping after rain storms.

3. Overburden Excavation. Overburden materials in the spillway excavation consist of tan to reddish-brown fine-grained sand mixed with varying amounts of clay, silt, and gravel as previously described. Within the limits of the old spillway the overburden had been removed during construction leaving only primary strata exposed on the spillway floor. Excavation for the new spillway began in April 1984. Overburden materials, where present, were excavated using Caterpillar scrapers pushed by Caterpillar D6 and D8 bulldozers. Suitable overburden materials removed from the spillway excavation were used as fill in a berm being constructed on the downstream face of the main embankment as part of the same construction contract.

4. Rock Excavation. Primary material removed from the spillway excavation ranged from weathered sand and clay, to unweathered, sandy, soft shale, and soft to hard fine-grained sandstone. The methods used to excavated the primary material changed as the excavation neared final grade. The following methods were employed:

(a) Bulk excavation of the primary materials was accomplished in the same manner as the excavation of the overburden materials, i.e.,

Caterpillar scrapers pushed by D6 and D8 bulldozers (See Figure 3). Ripper equipped dozers plowed and loosened the material prior to removal. Most of this material was suitable for use as fill material in embankment berm. That material which was not suitable, either due to the presence of large pieces of sandstone or too much sand, was spoiled in on-site waste areas.

(b) Bulk excavations were halted a minimum of 2 feet above final grade. Final grade surfaces were required to be covered within 4 hours of excavation. Excavation of the final 2+ feet of primary material in the areas beneath the spillway structure was accomplished with a Warner Swassey Model G-1000 Gradall (track-mounted), and a Catapillar Model 235 backhoe. As shown on Figure 4, the Gradall, with its wide, smooth-edged bucket was used to cut the flat surfaces to final grade, whereas the backhoe, with a deeper bucket equipped with 6-inch teeth, was more efficient at cutting ditches and at breaking through the moderately hard sandstone layers that were occasionally encountered. No blasting was required for any of the excavation or handling of materials during this project.

5. **Overexcavation.** A significant amount of overexcavation occurred during this project. The amount of overexcavation can be estimated by the amount of overrun in the sand required to construct the filter blanket between the excavated surface and the protective concrete slab beneath the structure. Using the designed thickness of the filter blanket, 6 inches, the estimated amount of sand required was 5465 cubic yards. Records show that 9134 cubic yards of sand were delivered to

Fig. 3 - Bulk excavation down to grade plus a minimum of 2 feet is accomplished with scrapers pushed by bulldozers

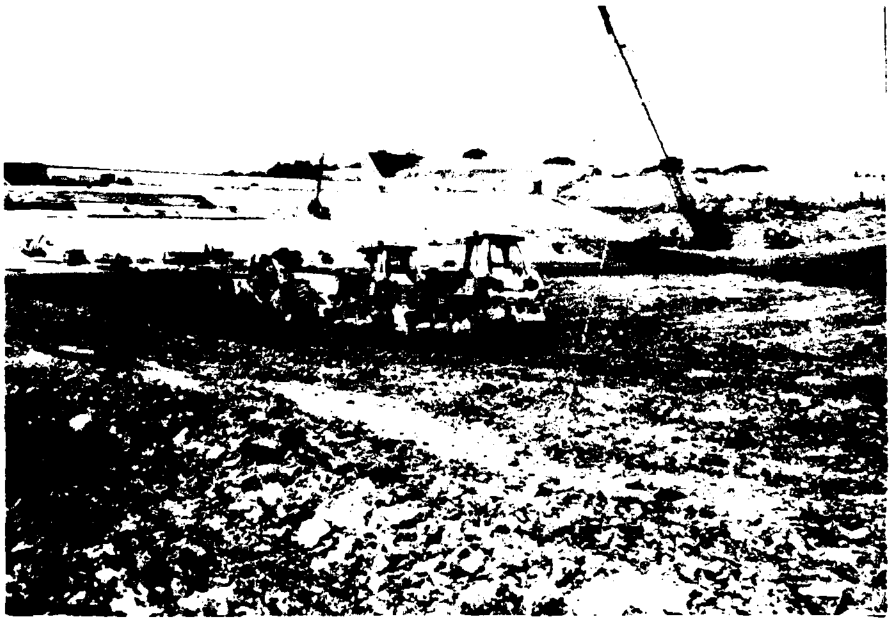


Fig. 4 - Neat-line excavation is accomplished with Gradall equipped with straight-edged bucket

the site. Although it is estimated that as much as 20 percent of the overrun was due to waste, there were also numerous occasions when the excavation surface was measured in excess of a foot below grade. The following factors resulted in overexcavation:

(a) One factor was the angle or slope of the excavation. Past experience has shown that excavating through horizontally layered strata at an angle is very difficult to master even with experienced equipment operators. The horizontal layers usually break unevenly, leaving a stair-step appearance, especially if their hardness is inconsistent, as was the case in this excavation.

(b) Another factor contributing to overexcavation was the tendency of the Contractor to attempt to excavate to grade and backfill very large areas each day. Contract specifications required that when excavating in primary material, the exposed surface was to be cleaned and covered with backfill (either filter sand or protective concrete) within 4 hours of achieving final grade. In order to excavate, clean and cover larger areas within the required time frame the accuracy of excavating was sometimes sacrificed, resulting in overexcavation.

(c) A minor amount of overexcavation was caused by the presence of bedrock weaknesses such as jointing, fracturing, or soft pockets. The locations of these areas are shown on the Structure Foundation Map, Plate 10. Excavation in these areas typically resulted in the material breaking out irregularly, leaving a depression or a vertical face. Another example was the rock breaking out along a softer,

weaker horizontal bedding plane which could be up to several inches below the desired grade.

In areas where overexcavation was the direct result of naturally occurring weaknesses in the foundation bedrock, the Contractor was paid for the extra amount of excavation and backfill. The quantities were measured and agreed upon by representatives of the Government and the Contractor immediately after excavation and before placement of backfill. Under this agreement the Government paid for a total of 354 cubic yards of extra sand, and 61 cubic yards of extra concrete.

6. **Foundation Preparation.** Preliminary test results indicated the need to minimize the exposure time of the primary material in order to retard change in moisture content and subsequent deterioration. A minimum of 2 feet of undisturbed primary protective cover was left on all rock foundation surfaces for subsequent removal immediately prior to backfill with filter sand or protective concrete.

(a) Foundations Beneath the Structure. Each day the final 2 + feet of primary material was excavated from an area using the Gradall or the backhoe. Upon achieving final grade, all loose, drummy, or otherwise unsatisfactory rock was removed and the surface was cleaned using compressed air. Figures 14 thru 32 show typical foundation surfaces. While the surface was being cleaned the Contractor's survey team assisted the CE geologist in taking final grade cross-sections and mapping any geologic features in the foundation. Immediately after the cleaning and mapping were completed, and the foundation was

approved by the inspecting geologist, Aerospray 70, a resin-type sealer manufactured by the American Cynamid Company, Wayne, New Jersey, was mechanically sprayed onto the foundation surface. The surface was then covered with either filter sand in the area beneath the spillway floor, or protective concrete in the area beneath the spillway training walls. A complete record of foundation approval is presented on Plate 13.

The use of Aerospray 70 was ineffective in areas of predominantly sand or sandy material. It was observed that in sandy material, the Aerospray mixture actually penetrated and softened or loosened the top $\pm$ 1-inch of material, making the surface soft and slippery. The Aerospray was effective in the shaly zones of the foundation. Therefore, the decision whether or not to use the Aerospray was made on a daily basis by the CE geologist, depending on the type of material exposed on the excavation surface.

(b) Foundations Adjacent to the Structure. Foundations adjacent to the structure include unweathered strata of the Woodbine Formation. The excavation slopes beyond the limits of the spillway structure foundation were essentially excavated to final grade during the initial spillway excavation. Primary material immediately adjacent to the outside toe of the training walls was excavated to a 1 vertical on 1 horizontal slope and allowed to stand during the period of construction. Adjacent to each wall the 1 vertical on 1 horizontal slope came up to a specified height, then changed to a 1 vertical on 3.5 horizontal slope to the top of the excavation. After the training walls were

completed, non-expansive material was placed between the training walls and the 1 vertical on 1 horizontal slope. Before placement of fill, the slope was hand-cleaned of loose, deteriorated, or otherwise unsatisfactory materials. Figure 33 shows an area of the 1 vertical on 1 horizontal slope being backfilled with non-expansive material.

(c) Overburden. Overburden materials exposed in the excavation slopes are shown on Plate 9. Horizontal and vertical limits of the overburden are shown on the cross-section on Plate 12. No backfill occurred adjacent to overburden materials. Overburden materials exposed in the slopes were covered with topsoil and turf to protect against erosion.

7. **Safety.** The slopes of the excavation were designed so that there would be no requirement for protection against slides and rock falls within the excavation. However, one minor slide did occur in a nearly vertical shale face about 300 feet left of centerline at station 14 + 50. (See Figure 6) After a significant weekend rain it was discovered that about 20 cubic yards of material had fallen down the slope, possibly the result of water entering an isolated zone of jointing behind the shale mass. Fortunately there were no workmen or equipment immediately below the slide area at the time of occurrence. To preclude future slope stability problems the Contractor was directed to lower the top of the slope as the excavation deepened, thereby maintaining a decreased standing height. The remainder of the excavation slopes remained stable throughout the construction period.

Fig.5 - Parabolic-shaped slab at top of spillway slope - note collars placed at rock anchor locations

Fig.6 - Slide area shown in upper center portion of photo - note nearly vertical slopes

VI FOUNDATION ANCHORS

1. **General**. Permanent foundation anchors were installed in the existing spillway apron at Grapevine Dam and in the newly constructed chute and stilling basin. A total of 3549 foundation anchors were installed to a minimum depth of 16 feet below the surface of the apron slab in the existing section and the protective concrete slab in the new section. A plan of rock-anchor installation is presented on Plate 14.

2. **Equipment**. The 6-inch diameter holes for the foundation anchors were drilled using a Gardner-Denver RDC-16B track-mounted pneumatic drill, shown on Figure 7. Two types of bits were used for drilling: The majority of drilling was done using a 5½-inch drag bit in the soft shales, clays and sandstones; and, a 6-inch Varel Tri-cone rock-bit was used to penetrate the moderately hard to hard sandstone layers which were encountered. The anchors consisted of No. 11 rebar bent in an L-shape. The grout mixture placed around the anchors was mixed at a commercial off-site batch plant and delivered in ready-mix trucks. (See Figure 9) The grout was dumped into a hopper attached to a side-winder pump and subsequently pumped into the holes through a 1¼-inch ID flexible hose.

3. **Grout Mix Design**. One cubic yard of grout contained the following ingredients:

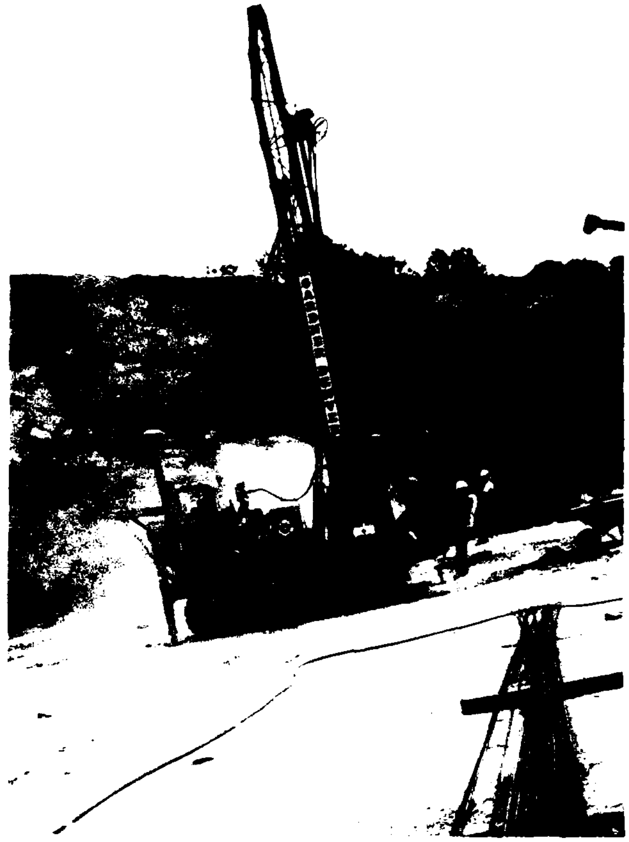


Fig. 7 - Anchor holes being drilled with track-mounted pneumatic drill

Fig. 8 - Anchor bars in place and ready for grouting

Fig.9 - Grout arrives at site and is dumped into hopper and pumped to hole locations

Fig.10 - Grout being placed in bottom of hole through $1\frac{1}{4}$-inch ID flexible rubber hose

Cement (Normal Portland Type I)	2.630 cf (5.5 sacks)
Fine Aggregate (0 - #4 Trinity Newark Sand).	19.189 cf
Water	4.776 cf (35.75 gal.)
Admixture (MB-322N-Water Reducing Admixture)	.405 cf
	27.000 cf

4. **Procedure.** Work on the Grapevine Spillway was scheduled so that the drilling and installation of foundation anchors could be accomplished simultaneously with other phases of construction. All of the anchors were installed perpendicular to the spillway structural concrete slab. Holes for installing the anchors were drilled through 6-inch diameter collars installed through the protective concrete slab and filter blanket. The anchor holes were drilled 15 feet into the foundation bedrock. Upon reaching the required depth the holes were blown clean using compressed air and tightly plugged until the subsequent insertion of anchor bars and grout. The normal procedure was to drill and plug approximately 50 anchor holes, insert the anchor bars, and place grout, all within 2 to 3 consecutive days. After the anchor bars were fixed in the holes at the correct elevation the grout mixture was pumped through a 1¼-inch ID flexible rubber hose extending to the bottom of the hole (Figure 10). Pumping continued until pure grout returned to the surface, indicating the hole was filled. The hose was then withdrawn from the hole while pumping continued. The grout in the hole was then vibrated from the bottom of the hole up (Figure 11). Finally, after vibrating was completed, the hole was topped off with more grout, completing the installation.

Fig.11 - Grout being vibrated in the hole

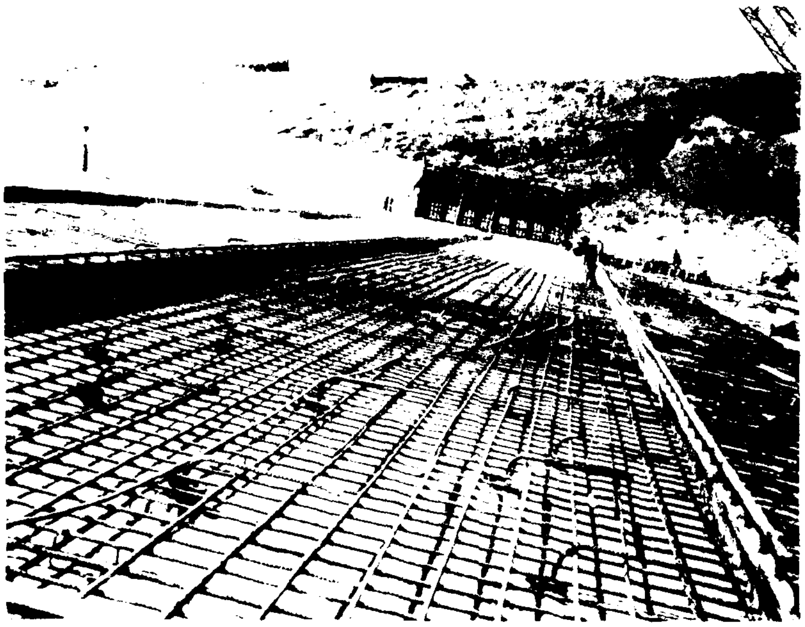


Fig.12 - Anchor bars and steel in place ready for concrete

5. **Modification.** In accordance with the Value Engineering Incentive Clause of the contract, the Contractor submitted two proposals to modify the rock anchor design and installation. The first proposal was to eliminate the 1/2-inch grout tube attached parallel to each anchor through which grout would be pumped causing the hole to be filled with grout from the bottom up. Instead, grout would be pumped to the bottom of the hole through a 1/2-inch steel pipe which would be retracted as the hole filled with grout. The second proposal was to reduce the number of spacers fixed to each anchor from four to two.

Both of the proposals were accepted by the SWF Value Engineering Officer, resulting in Modification No. P00005, DO-C0612 being issued on September 30, 1983. The net savings to the Government was $7,296.

After installation of the rock anchors began, the Contractor requested and was granted approval to fill the grout holes through a flexible hose, as described above, rather than through a steel pipe.

6. **Pull-Out Tests.** Two rock anchors were installed on February 8, 1984, for the purpose of conducting pull-out tests. Both were installed at design grade near the centerline of the spillway at approximate station 12 + 80, about 50 feet downstream from the end of the existing spillway apron. The pull-out tests were performed by Southwestern Laboratories' personnel. The initial tests conducted on Feb 23-24, 1984, were unsuccessful because of problems with the jack and jack support. The same anchor bars were retested on March 8, 1984, with successful results. The anchors were stressed to 45 tons during which

Fig. 13 - Pull-out test in progress

the maximum deformation observed was 0.551 inch. Figure 13 shows the pull-out tests in progress.

As a result of this test it was concluded that the design for the spillway slab anchors was satisfactory, and the Contractor was given authorization to proceed with the fabrication and installation of the rock anchors based on the design given in the contract plans and specifications. A complete record of the pull-out test data is on file in the SWF Design Branch, Structural Section.

VII POSSIBLE FUTURE PROBLEMS

1. **Observations.** There were no unanticipated foundation conditions discovered during construction of the Grapevine Spillway Modification which would pose a threat to the stability of the structure. All foundation surfaces were stable and sufficiently competent as anticipated in the design, and remained so until covered by filter sand or protective concrete.

The materials exposed in the upper portion of the excavation are highly erodible in nature. The establishment and maintenance of a good turf zone will be required in this area in order to prevent severe erosional damage and subsequent heavy siltation over the spillway floor.

The channel downstream from the new spillway is founded in materials varying from loose clayey sand to soft to moderately hard, very fine-grained, weakly to moderately cemented sandstone. The channel will suffer severe erosional damage in the event of a major flow event. Measures to control erosion in the spillway discharge channel should be considered.

2. **Future Considerations.** The excavation of a 1 horizontal on 4 vertical slope, as required in the excavation for the spillway end sill, is very difficult to achieve. Normally, when excavating in soft materials where line drilling would not be required, a Contractor will use a backhoe, which will result in a rectangular-shaped ditch, as

was the case in this project (see Figure 32). Consideration should be given to designing a rectangular-shaped end sill excavation with a typical bottom width conforming to the width of a typical backhoe bucket.

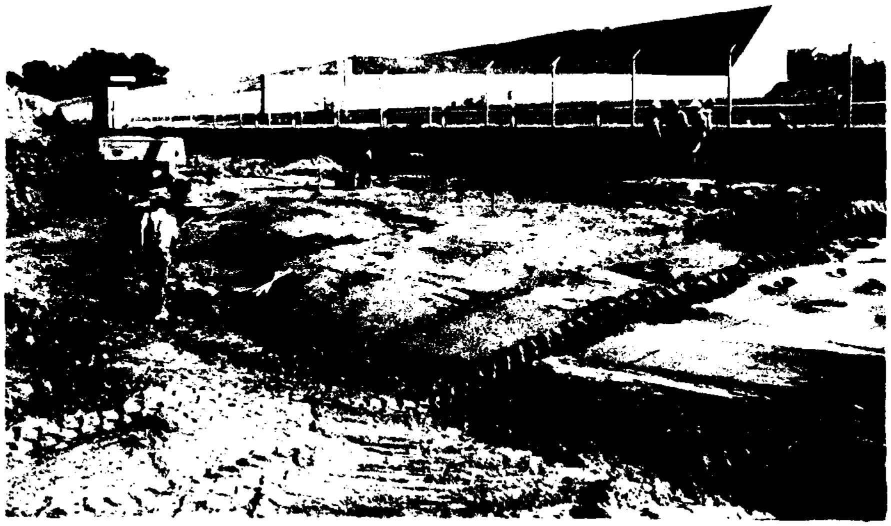


Fig. 14 - Exposed foundation surface - 25 April 1984

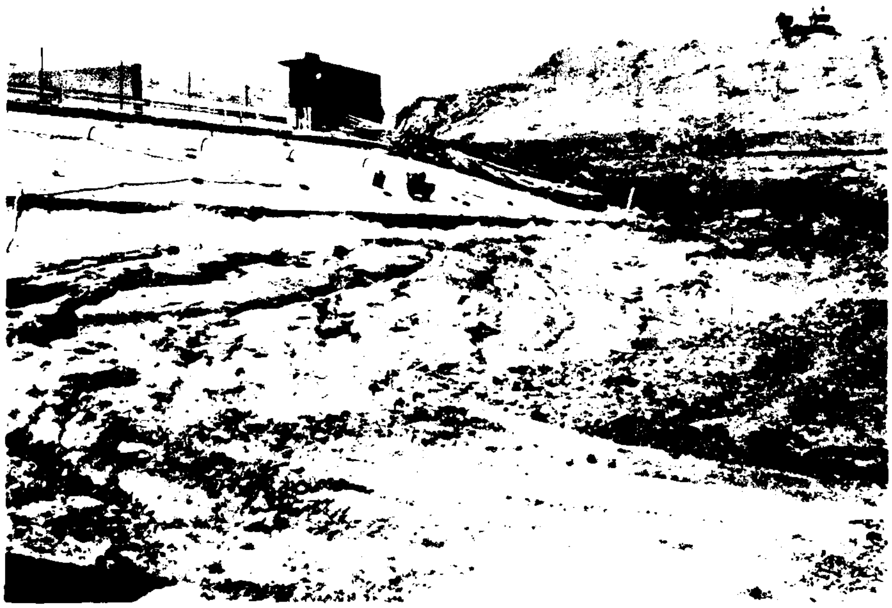


Fig. 15 - Exposed foundation surface - 9 May 1984

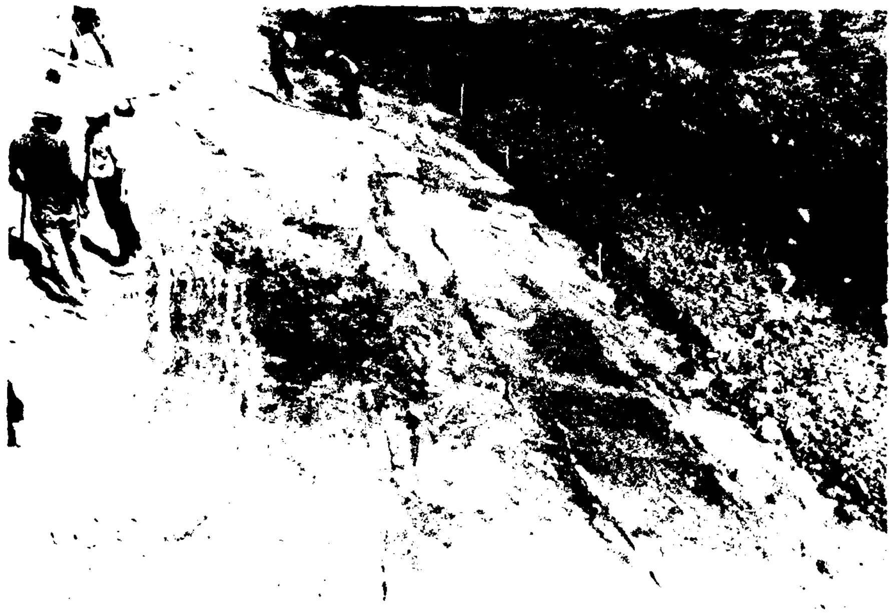


Fig. 16 - Exposed foundation surface - 9 May 1984

Fig. 17 - Exposed foundation surface - 25 June 1984

Fig. 18 - Exposed foundation surface - 10 July 1984

Fig. 19 - Exposed foundation surface - 10 July 1984

Fig. 20 - Exposed foundation surface - 18 July 1984

Fig. 21 - Exposed foundation surface - 25 July 1984

Fig. 22 - Excavation for cut off wall - 28 June 1984

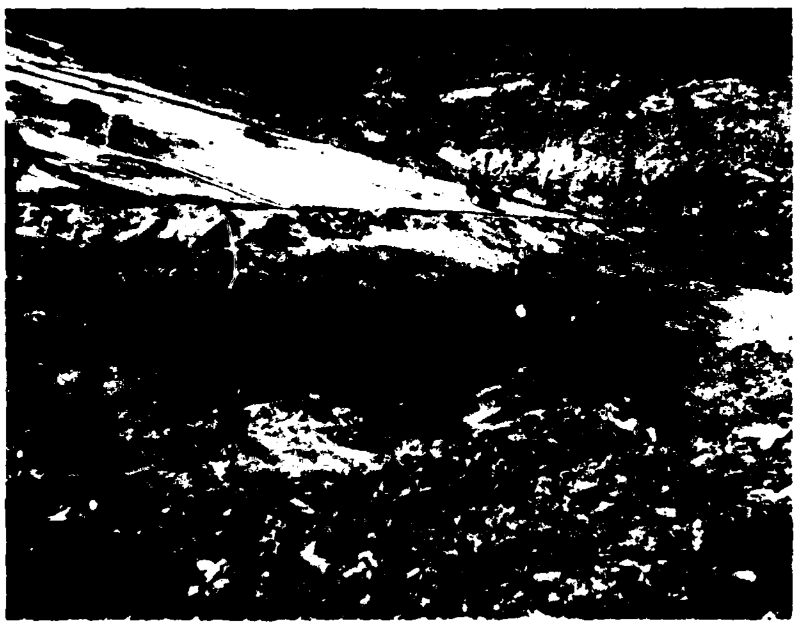


Fig. 23 - Exposed foundation surface - 10 September 1984

Fig. 24 - Exposed foundation surface - 10 September 1984

Fig. 25 - Exposed foundation surface - 17 September 1984

Fig. 26 - Exposed foundation surface - 9 October 1984

Fig. 27 - Exposed foundation surface - 9 October 1984

Fig. 28 - Exposed foundation surface - 20 November 1984

Fig. 29 - Exposed foundation surface - 6 March 1985

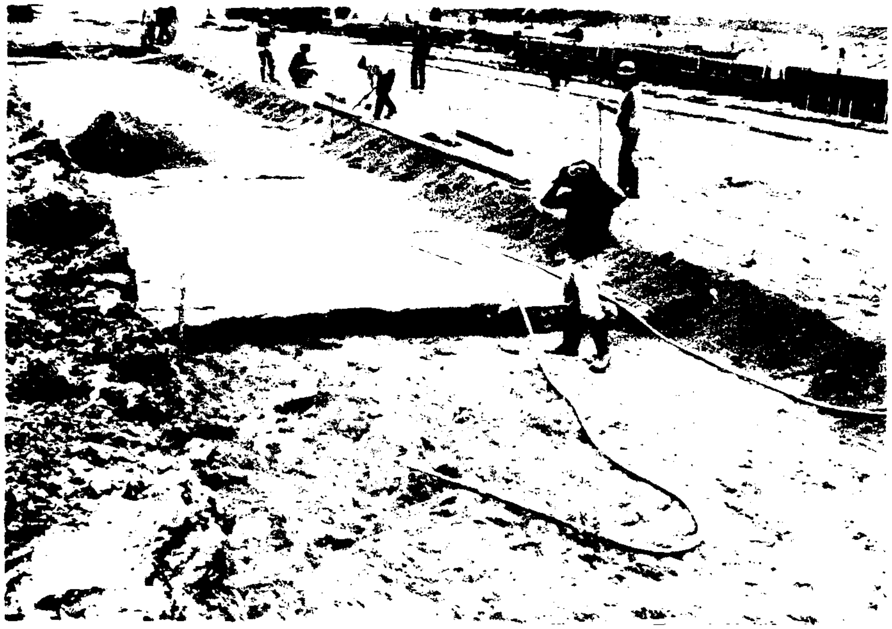


Fig. 30 - Exposed foundation surface - 6 March 1985

Fig. 31 - Exposed foundation surface - 7 March 1985

Fig. 32 - End sill excavation - 5 April 198?

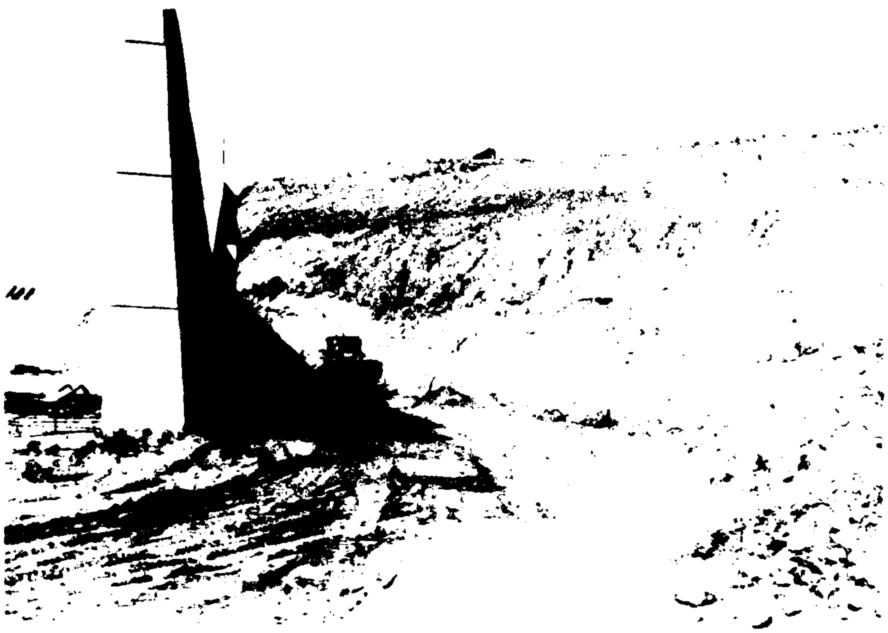
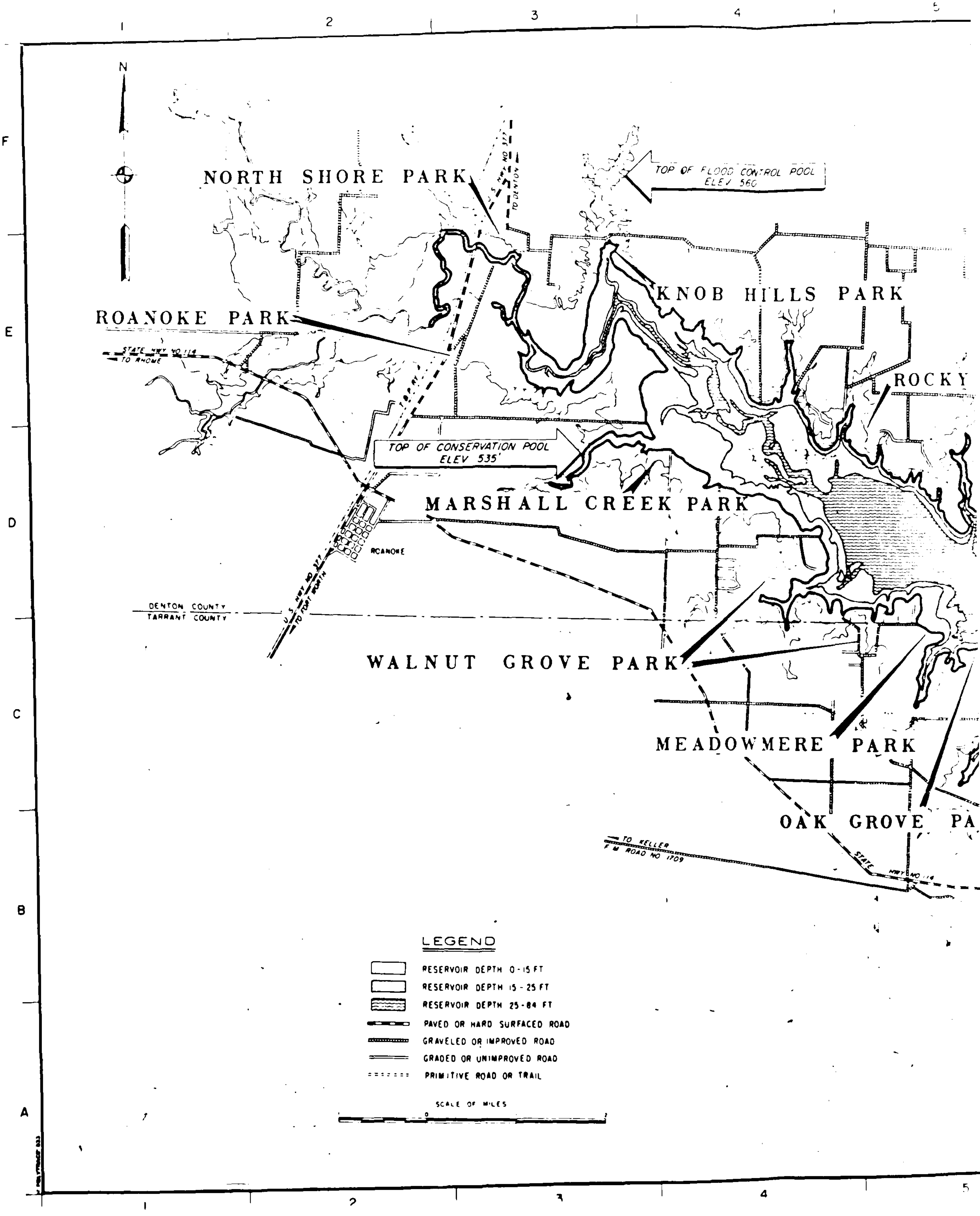


Fig. 33 - Placement of nonexpansive backfill between training wall and excavation slope


NORTH SHORE PARK
U.S. HWY NO 377
TO DENTON
TOP OF FLOOD CONTROL POOL
ELEV 560
KNOB HILLS PARK
ROANOKE PARK
STATE HWY NO 114
TO RHOME
ROCKY
TOP OF CONSERVATION POOL
ELEV 535'
MARSHALL CREEK PARK
ROANOKE
DENTON COUNTY
TARRANT COUNTY
U.S. HWY NO 377
TO FORT WORTH
WALNUT GROVE PARK
MEADOWMERE PARK
OAK GROVE PA
TO KELLER
F M ROAD NO 1709
STATE HWY NO 114
LEGEND
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RESERVOIR DEPTH 15-25 FT
RESERVOIR DEPTH 25-84 FT
PAVED OR HARD SURFACED ROAD
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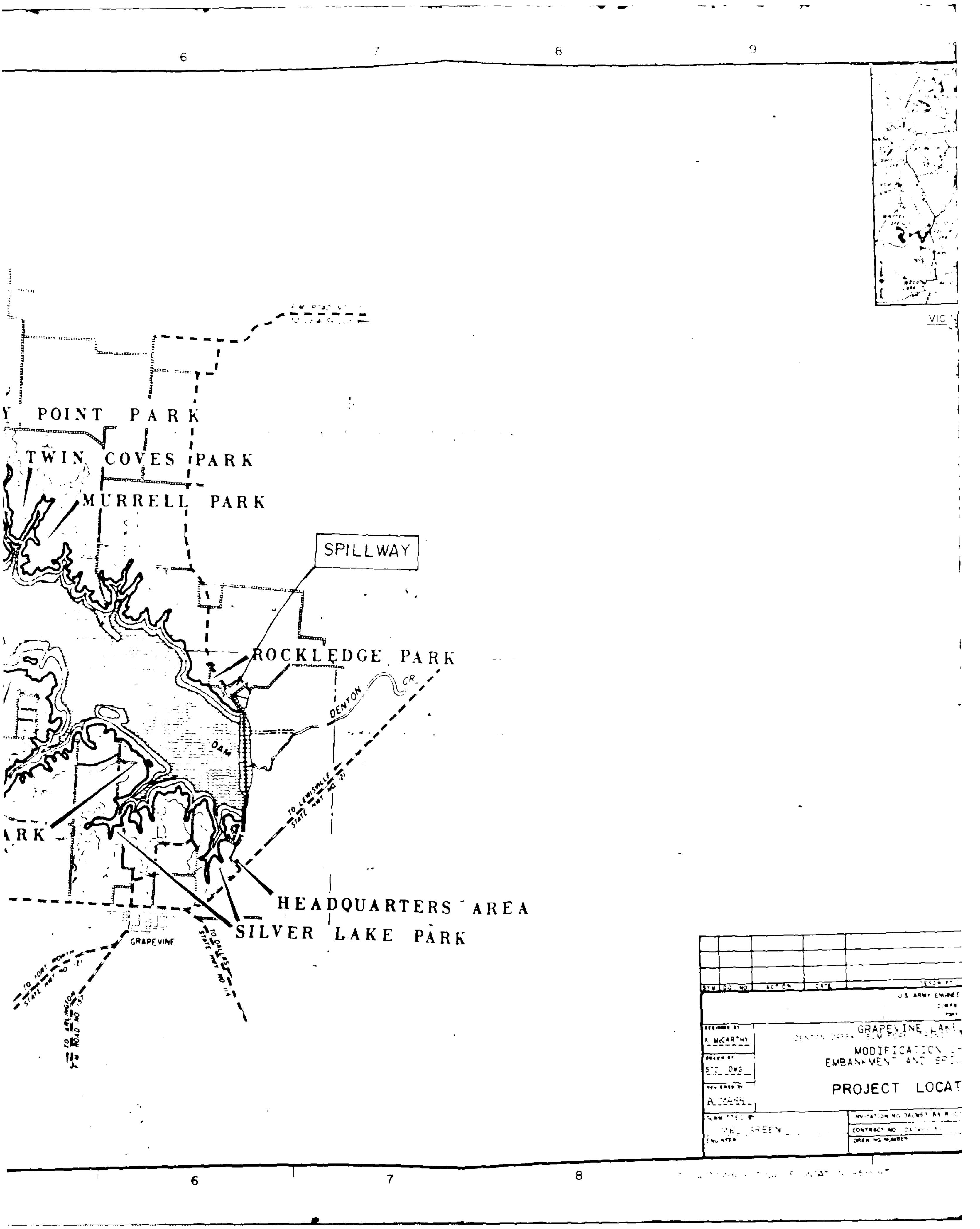
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POINT PARK
TWIN COVES PARK
MURRELL PARK
SPILLWAY
ROCKLEDGE PARK
DENTON CR.
DAM
TO LEWISVILLE STATE HWY NO 121
HEADQUARTERS AREA
SILVER LAKE PARK
GRAPEVINE
TO FORT WORTH STATE HWY NO 121
TO ARLINGTON F.M. ROAD NO 157
TO DALLAS STATE HWY NO 114
VIC
SYM
DO. NO.
ACTION
DATE
U.S. ARMY ENGINE
DESIGNED BY
A. McCARTHY
DRAWN BY
STD. DWG.
REVIEWED BY
SUBMITTED BY
MEL GREEN
ENGINEER
GRAPEVINE LAKE
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CONTRACT NO.
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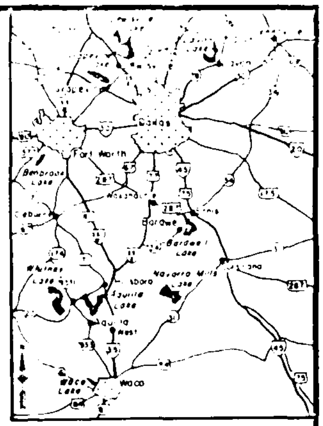

VICINITY MAP
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SYM	DO NO.	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: K. McCARTHY
DRAWN BY: STD. DWG.
REVIEWED BY: A. MARR

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

MODIFICATION OF
EMBANKMENT AND SPILLWAY

PROJECT LOCATION

3

SUBMITTED BY: MEL GREEN, ENGINEER

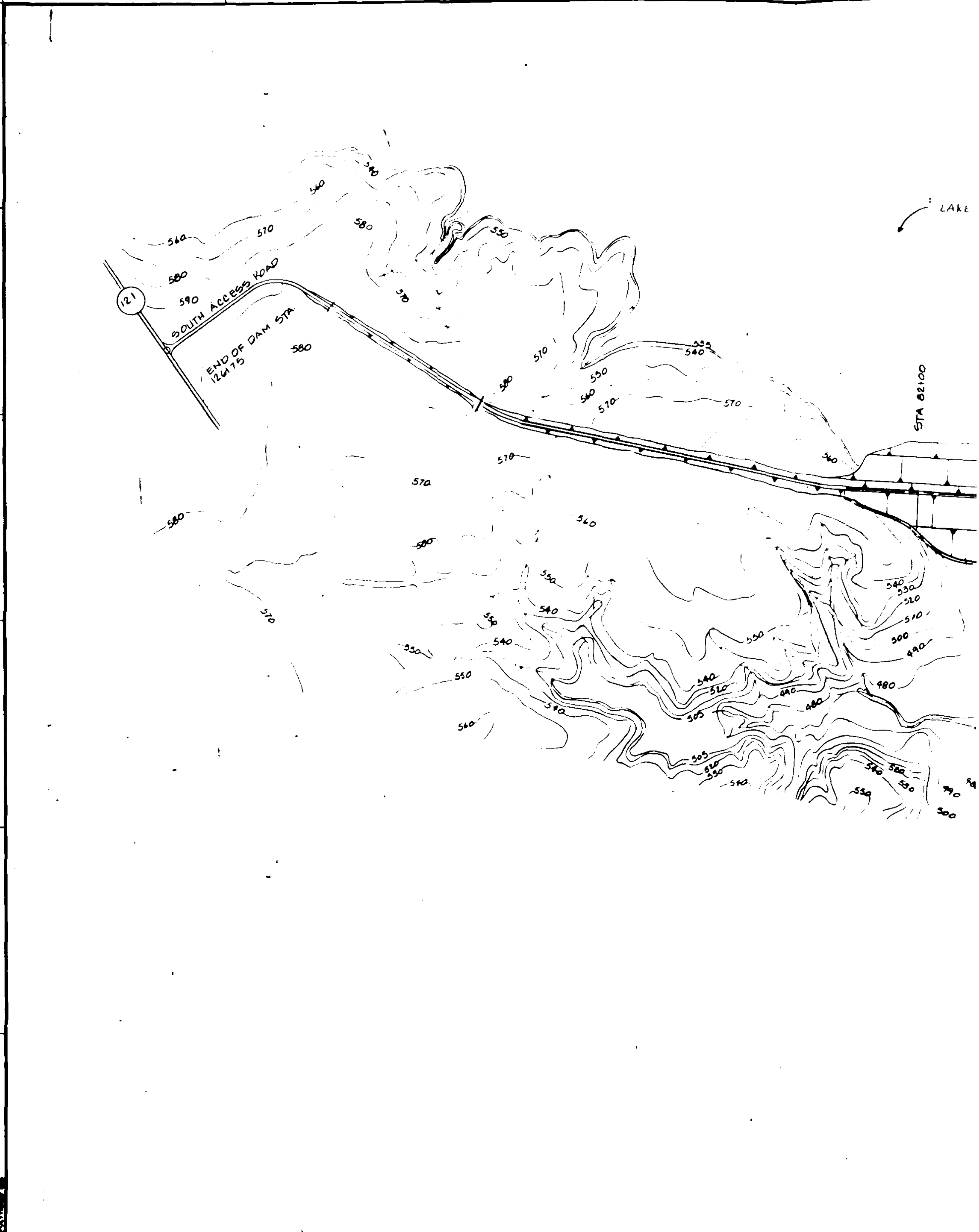
INVITATION NO. DACW63-83-B-0052 | DATE AUG 1983
CONTRACT NO. DACW63-83-C-0160
DRAWING NUMBER | SHEET NO. OF | PLATE 1

CONTRACT NO. DACW63-83-C-0160

8

TO APPENDIX FINAL FOUNDATION REPORT

1	2	3	4



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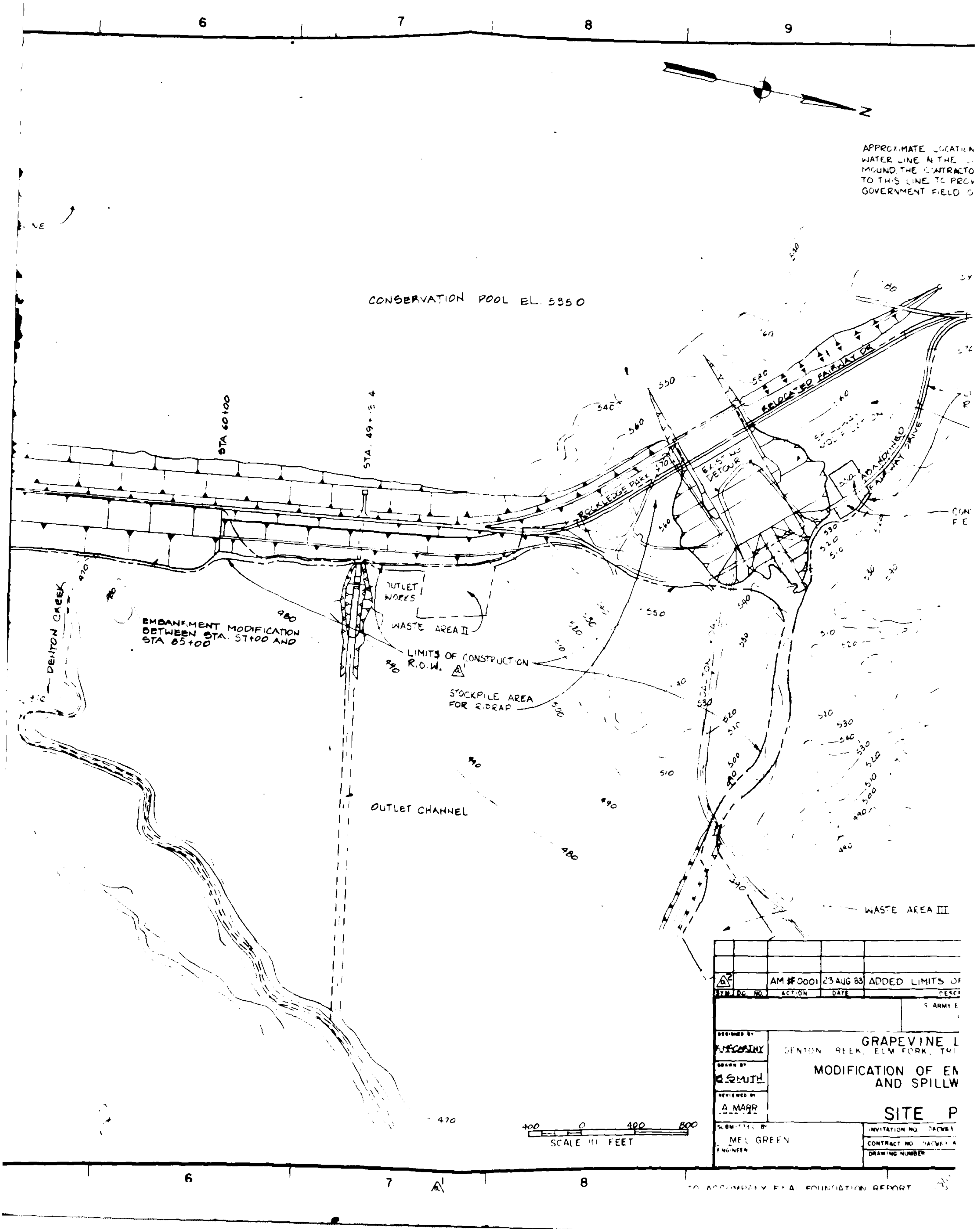

APPROXIMATE LOCATION
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STA 60+00
STA. 49+
RELOCATED FAIRWAY DR
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EXISTING DETOUR
ABANDONED FAIRWAY DRIVE
OUTLET WORKS
WASTE AREA II
EMBANKMENT MODIFICATION BETWEEN STA. 57+00 AND STA 65+00
DENTON CREEK
LIMITS OF CONSTRUCTION
R.O.W.
STOCKPILE AREA FOR RIPRAP
OUTLET CHANNEL
WASTE AREA III
AM #0001
23 AUG 83
ADDED LIMITS OF
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DATE
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MODIFICATION OF EM
AND SPILLW
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McCARTHY
G. SMITH
A. MARR
MEL GREEN
SCALE IN FEET
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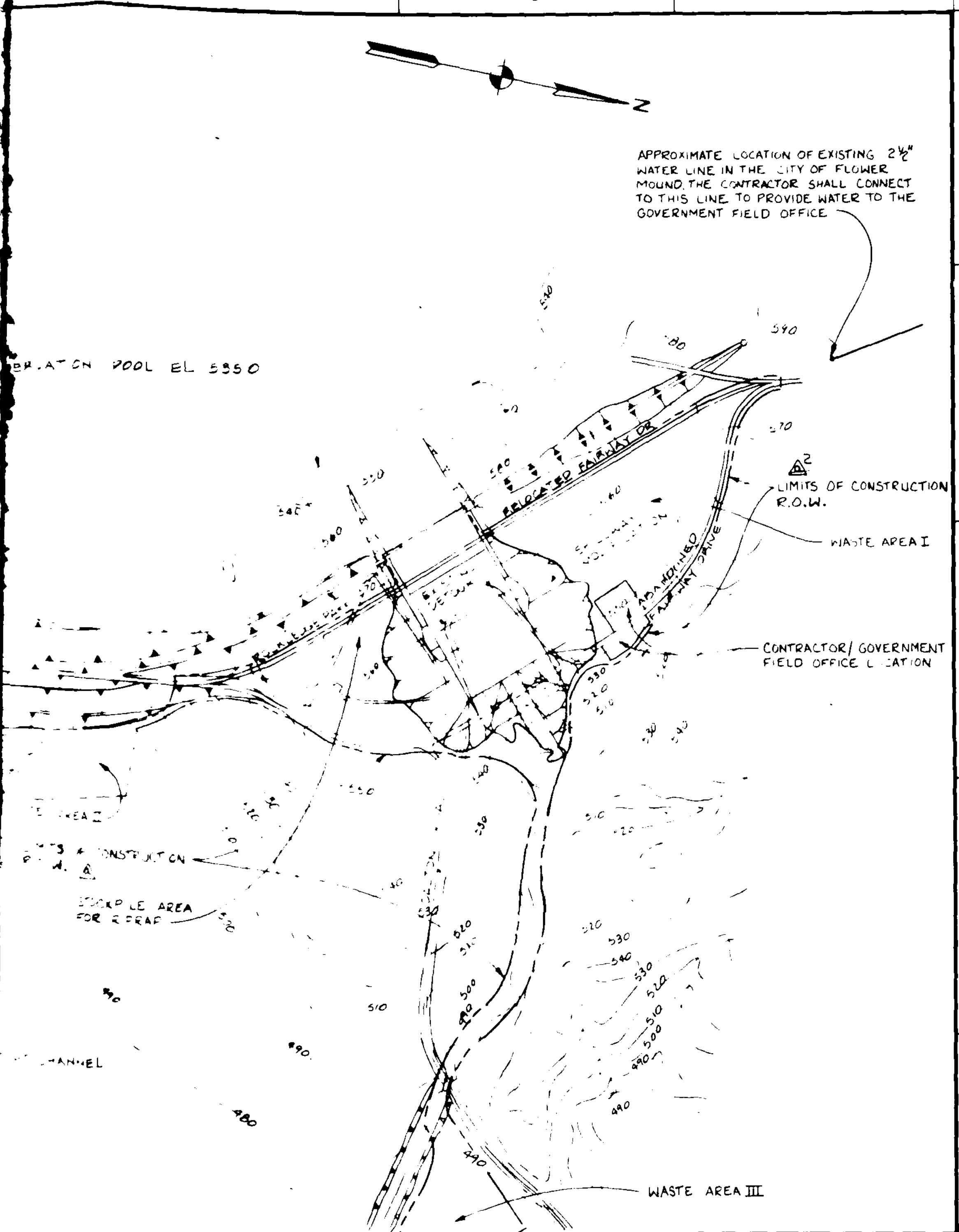
TO ACCOMPANY FINAL FOUNDATION REPORT



SYM	DO NO.	ACTION	DATE	DESCRIPTION OF REVISION
2		AM #0001	23 AUG 83	ADDED LIMITS OF CONSTRUCTION R.O.W.

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: McCARTHY
DRAWN BY: G.SMITH
REVIEWED BY: A. MARR
SUBMITTED BY: MEL GREEN, ENGINEER

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

MODIFICATION OF EMBANKMENT AND SPILLWAY

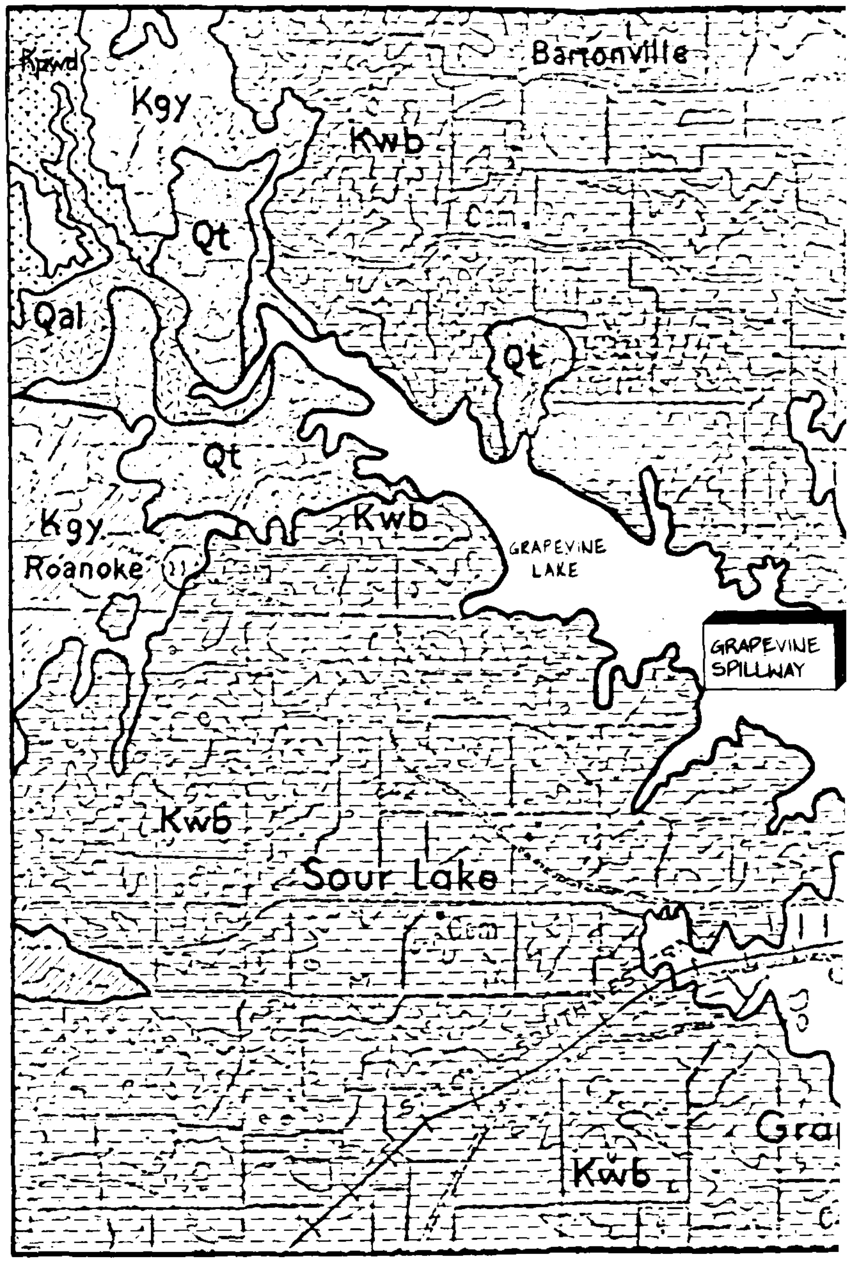
3

SITE PLAN

INVITATION NO. DACW63 83 B-0052 | DATE AUG 1983
CONTRACT NO. DACW63 83 C-0160
DRAWING NUMBER | SHEET NO OF | PLATE 2

CONTRACT NO. DACW63-83-C-0160

TO ACCOMPANY FINAL FOUNDATION REPORT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Roanoke
GRAPEVINE LAKE
GRAPEVINE SPILLWAY
Kwb
Sour Lake
Cem
Kwb

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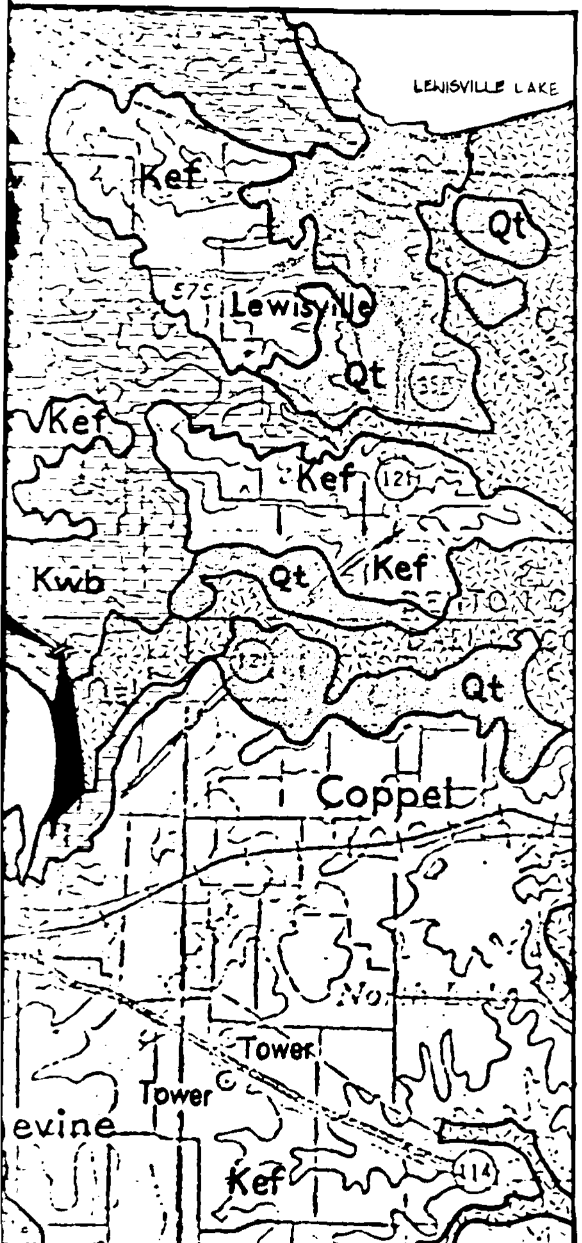

LEGEND

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UPPER CRETACEOUS	(Kef)	EAGLE FORD GROUP UNDIVIDED
	(Kwb)	WOODBINE FORMATION
LOWER CRETACEOUS	(Kgy)	GRAYSON MARL & MAIN STREET
	(Kpwd)	PAWPAW FORMATION

NOTES:

1. MAP REFERENCE UNIVERSITY OF TEXAS BUREAU OF ECONOMIC GEOLOGY, DALLAS SHEET, 1972, AND SHERMAN SHEET, 1967.

1 0 1

SCALE OF MILES

SYM	DG. NO.	ACTION	DATE

U S AR

DESIGNED BY A. MARR
DRAWN BY L. GOSS
REVIEWED BY A. MARR
SUBMITTED BY M. GREEN ENGINEER

GRAPEVINE
DENTON CREEK, ELM FORK,
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INVITATION NO.
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LEGEND

RECENT	(Qal)	ALLUVIUM
PLEISTOCENE	(Qt)	FLUVIATILE TERRACE DEPOSITS
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	(Kwb)	WOODBINE FORMATION
LOWER CRETACEOUS	(Kgy)	GRAYSON MARL & MAIN STREET
	(Kpwd)	PAWPAW FORMATION

NOTES:

1. MAP REFERENCE UNIVERSITY OF TEXAS BUREAU OF ECONOMIC GEOLOGY, DALLAS SHEET, 1972, AND SHERMAN SHEET, 1967.

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SCALE OF MILES

SYM.	DO. NO.	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY A. MARR
DRAWN BY L. GOSS
REVIEWED BY A. MARR

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

MODIFICATION OF
EMBANKMENT AND SPILLWAY

AREAL GEOLOGY

3

SUBMITTED BY M. GREEN ENGINEER

INVITATION NO. | DATE
CONTRACT NO.
DRAWING NUMBER | SHEET NO. OF | PLATE 3

CONTRACT NO.

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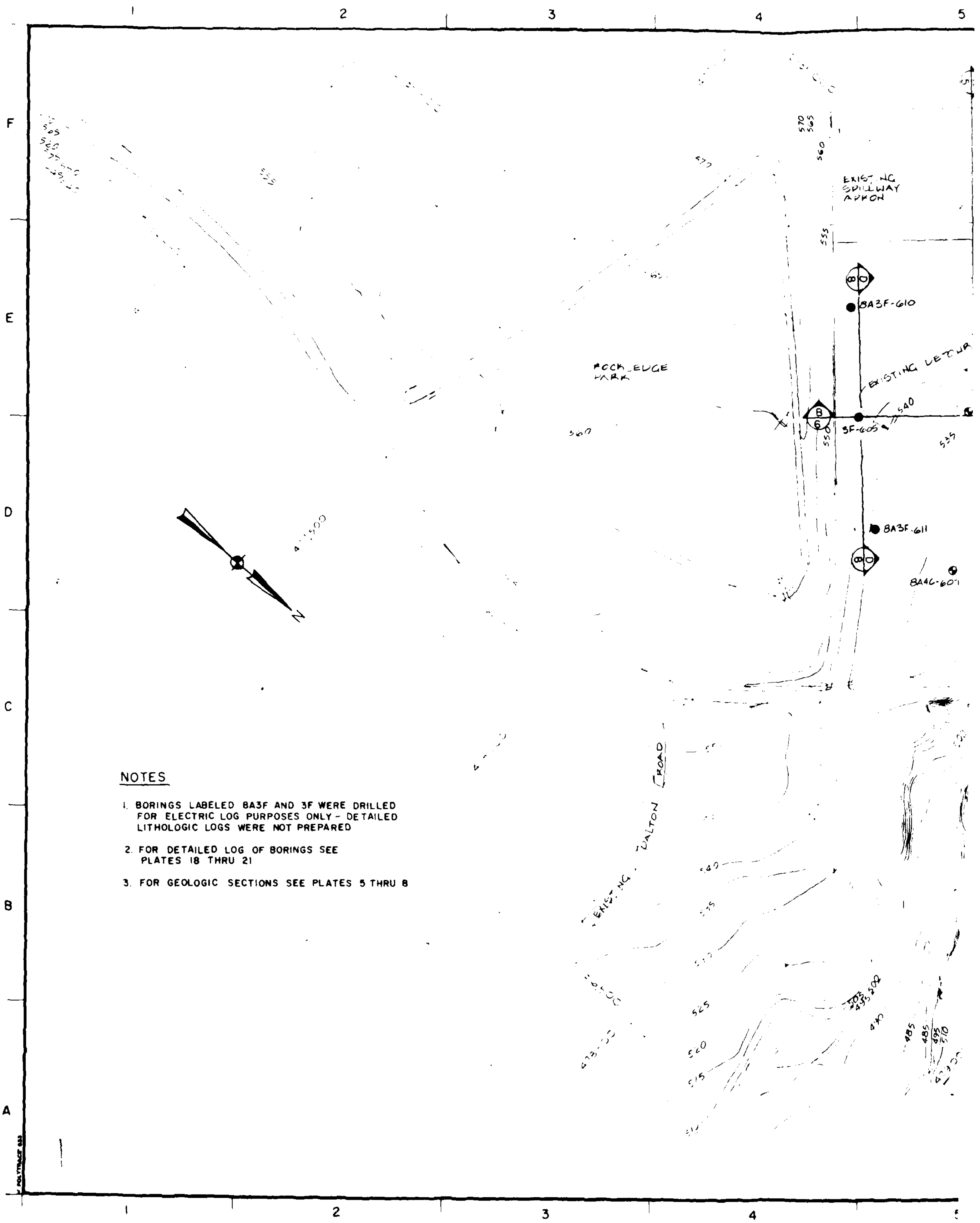
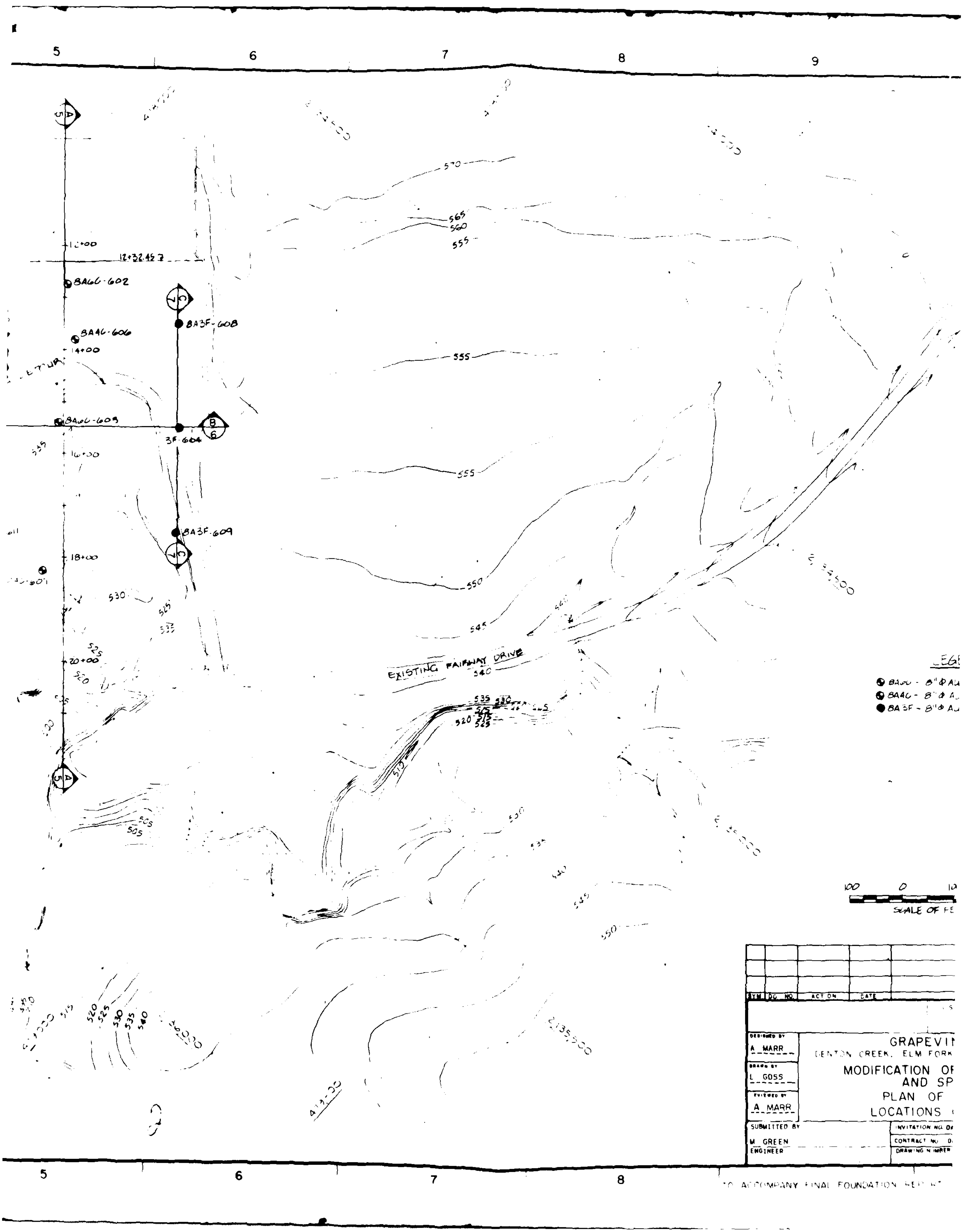


NOTES

1. BORINGS LABELED 8A3F AND 3F WERE DRILLED FOR ELECTRIC LOG PURPOSES ONLY - DETAILED LITHOLOGIC LOGS WERE NOT PREPARED
2. FOR DETAILED LOG OF BORINGS SEE PLATES 18 THRU 21
3. FOR GEOLOGIC SECTIONS SEE PLATES 5 THRU 8



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DOC NO
ACTION
DATE
DESIGNED BY
A. MARR
DRAWN BY
L. GOSS
REVIEWED BY
A. MARR
SUBMITTED BY
M. GREEN
ENGINEER
GRAPEVI
DENTON CREEK, ELM FORK
MODIFICATION OF
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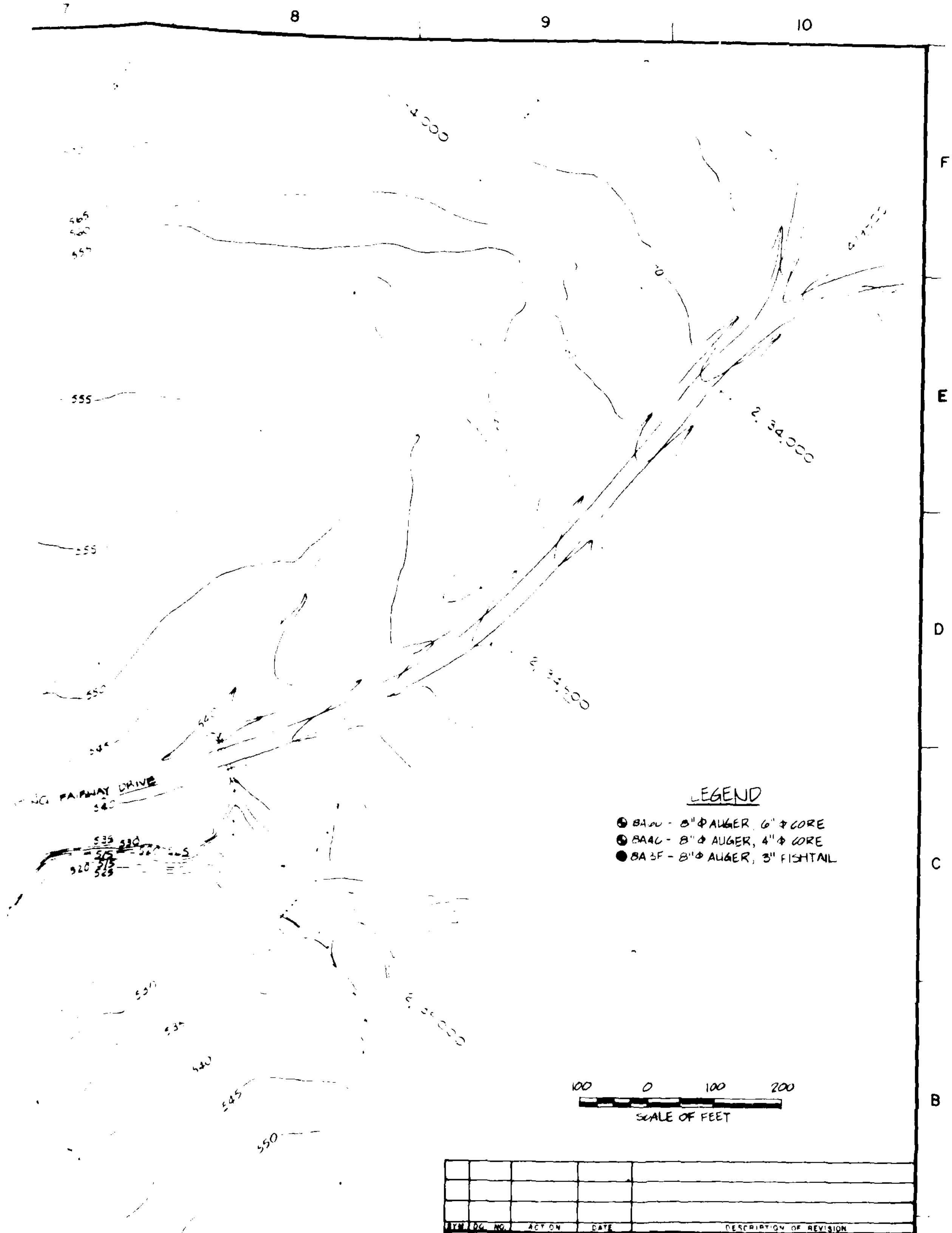
PLAN OF
LOCATIONS
INVITATION NO.
CONTRACT NO.
DRAWING NUMBER
TO ACCOMPANY FINAL FOUNDATION REPORT



U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

SYM	DG. NO.	ACTION	DATE	DESCRIPTION OF REVISION

DESIGNED BY A. MARR

DRAWN BY L. GOSS

REVIEWED BY A. MARR

SUBMITTED BY M. GREEN, ENGINEER

GRAPEVINE LAKE

DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

MODIFICATION OF EMBANKMENT AND SPILLWAY

PLAN OF BORINGS & LOCATIONS OF SECTIONS

3

INVITATION NO. DACW63 83 B 0052 — DATE AUG 1983

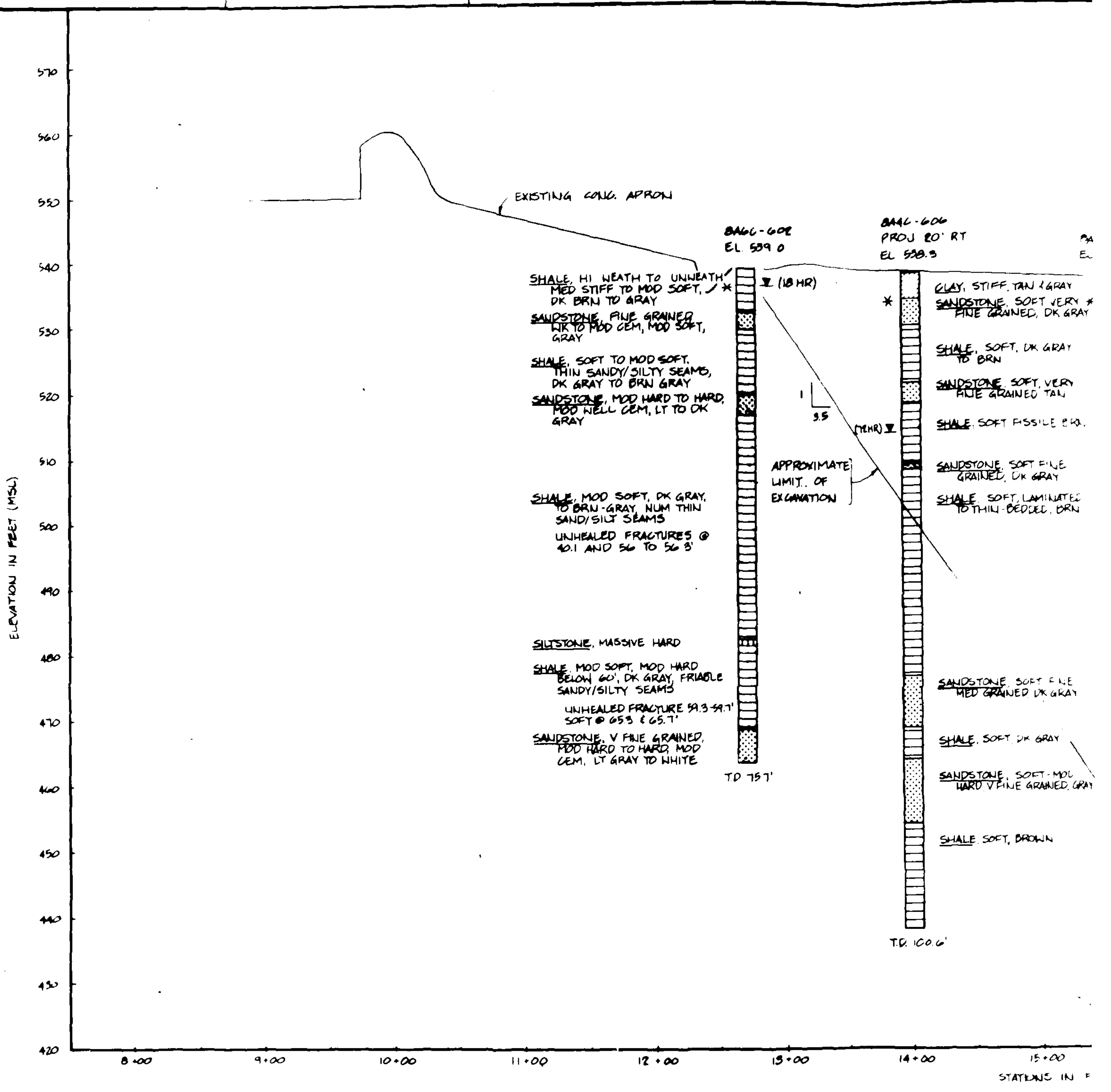
CONTRACT NO. DACW63 83-C 0160

DRAWING NUMBER — SHEET NO. OF

PLATE 4

CONTRACT NO. DACW63-83-C-0160

TO ACCOMPANY FINAL FOUNDATION REPORT



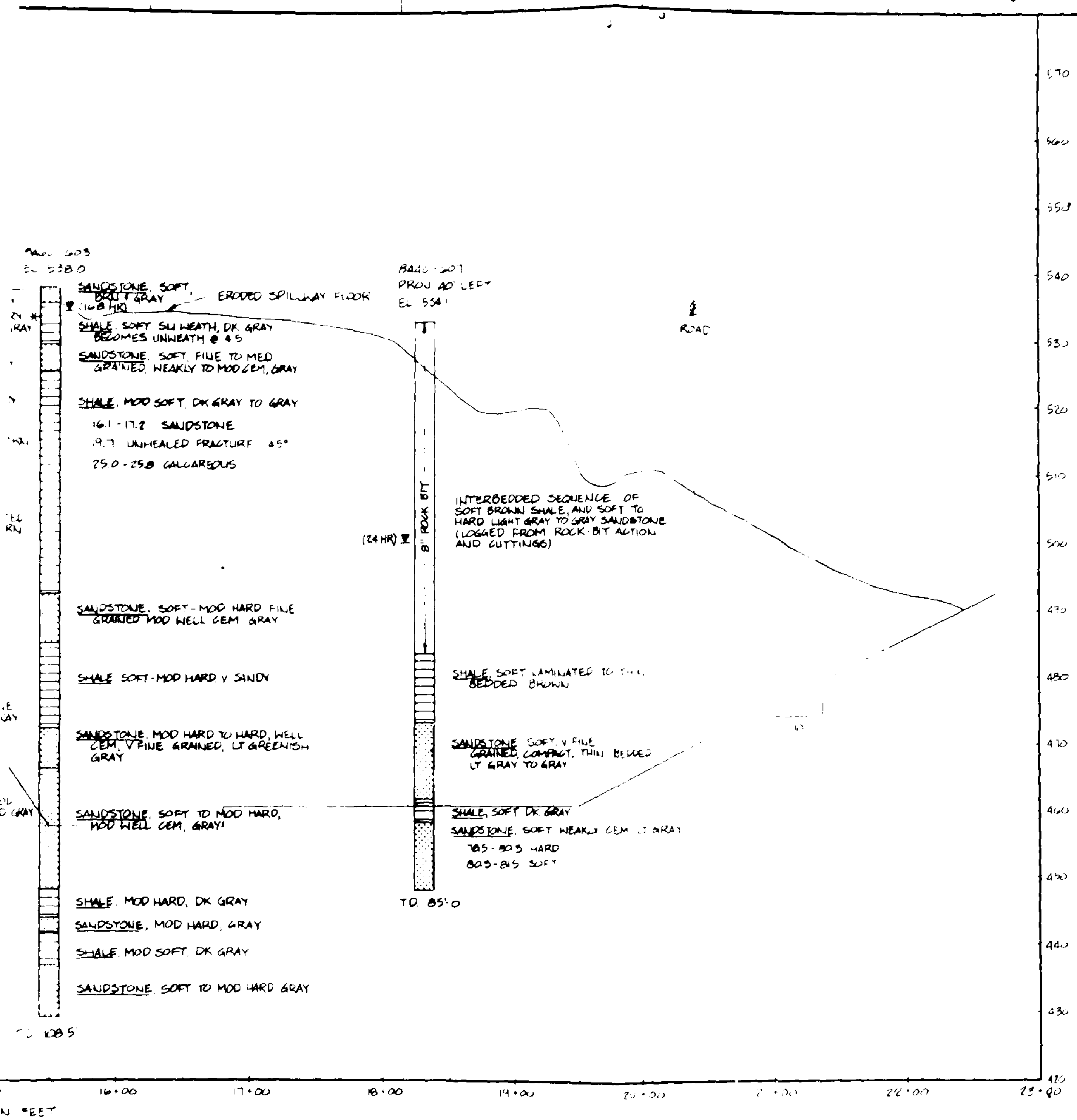
LEGEND

WOODBINE FORMATION (CRETACEOUS AGE)

- PREDOMINANTLY SANDSTONE W/ SHALE & SHALY SANDSTONE INTERBEDS
- PREDOMINANTLY SHALE W/ SANDSTONE & SANDY SHALE INTERBEDS

SPILLWAY CENTERLINE

SCALE: VERT - 1" = 1[illegible]
HORIZ - 1" = [illegible]



NE PROFILE

NOTES

1. DETAILED LOGS OF BORINGS ARE SHOWN ON PLATES 18 THROUGH 21
2. ▼ (72 HR) - WATER LEVEL 72 HOURS AFTER COMPLETION OF DRILLING
3. * - BASE OF WEATHERING

SYM	DWG. NO.	ACTION	DATE

DESIGNED BY: A. MARR
DRAWN BY: L. GOSS
REVIEWED BY: M. GREEN

GRAPEVINE

MODIFICATI
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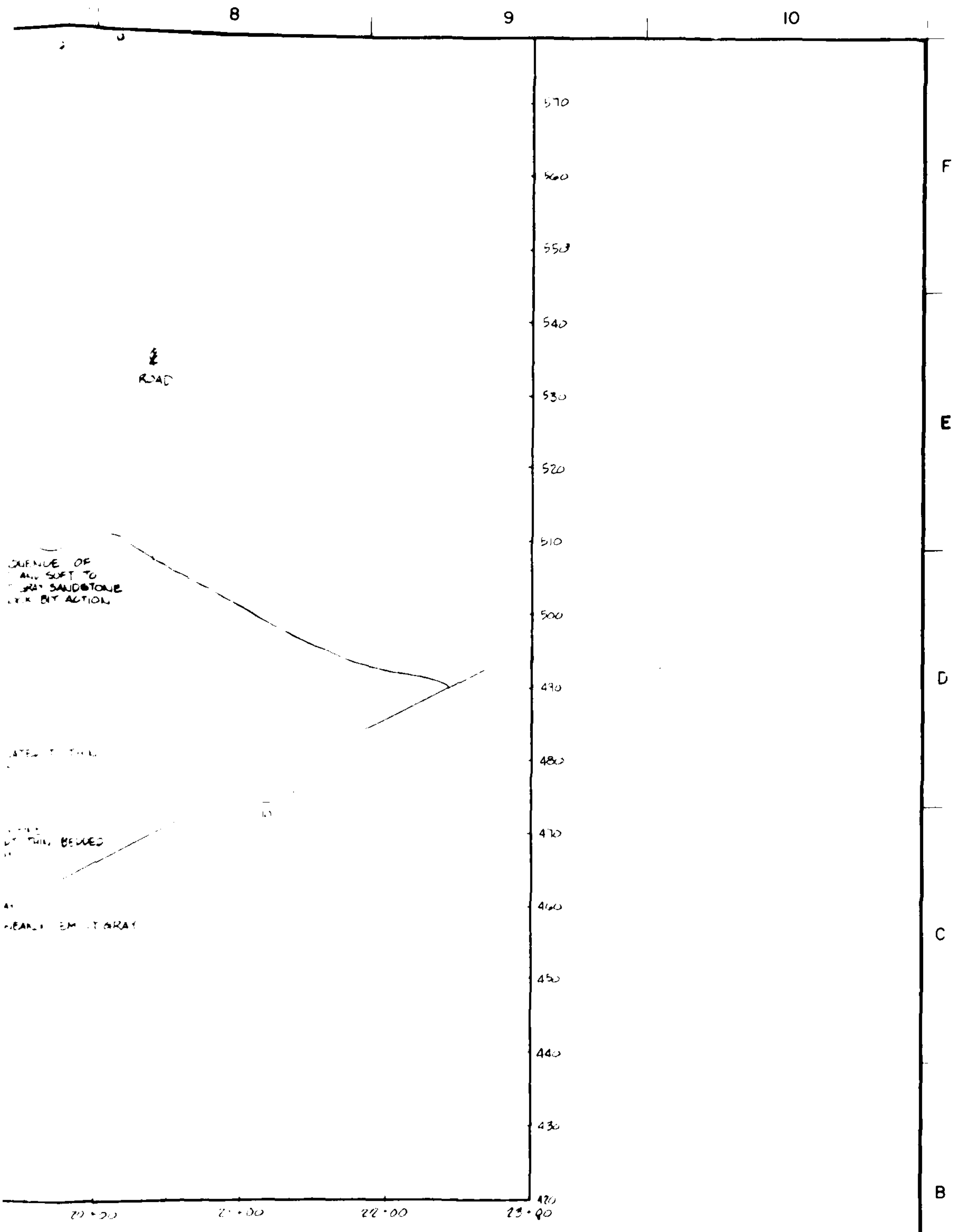
CENTERLINE

TO ACCOMPANY FINAL FOUNDATION REPORT



U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: A. MARR
DRAWN BY: L. GOSS
REVIEWED BY: M. GREEN

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

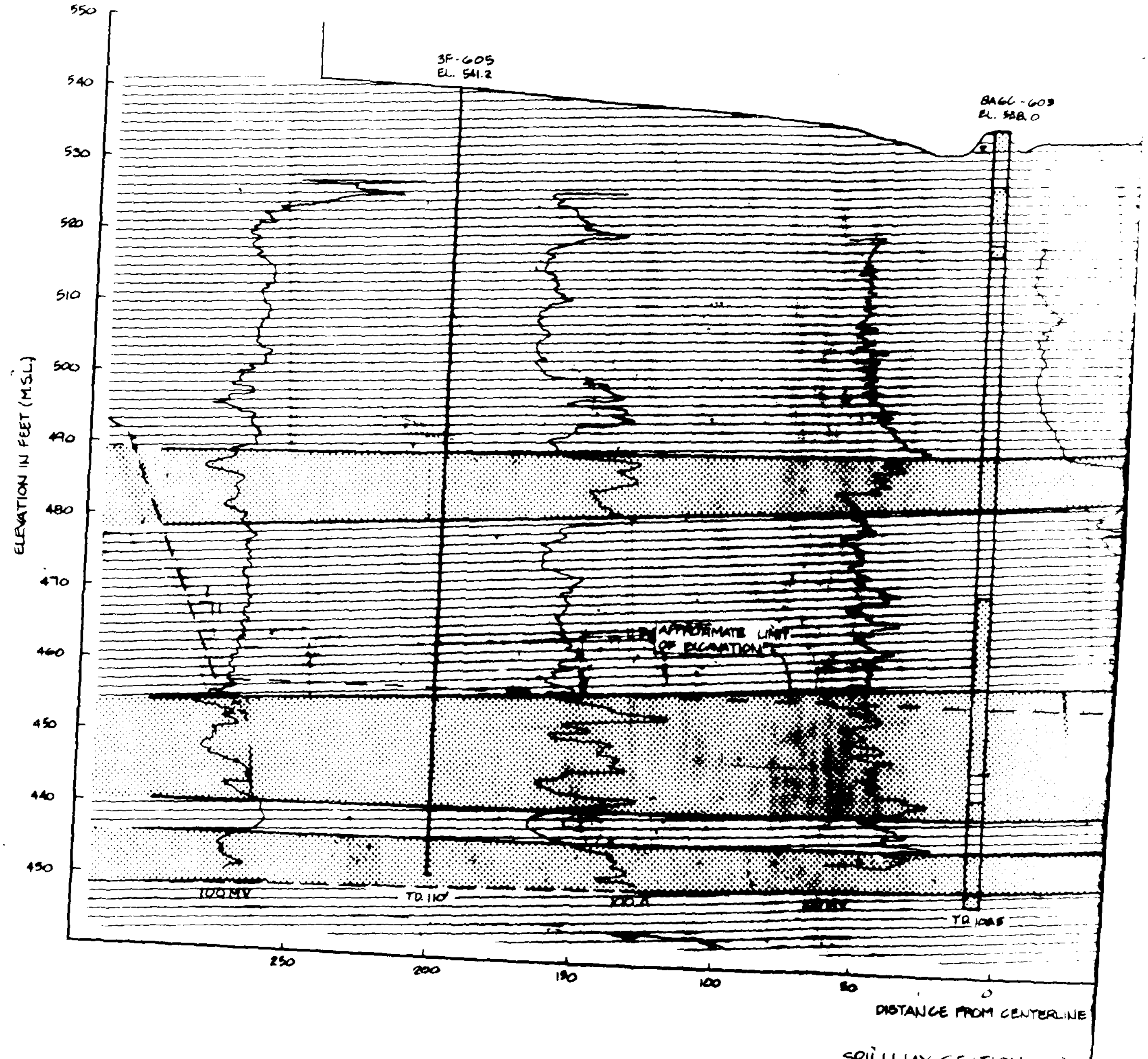
MODIFICATION OF
EMBANKMENT AND SPILLWAY

CENTERLINE PROFILE

SUBMITTED BY: M. GREEN, ENGINEER
INVITATION NO. | DATE
CONTRACT NO.
DRAWING NUMBER | SHEET NO.

PLATE 5

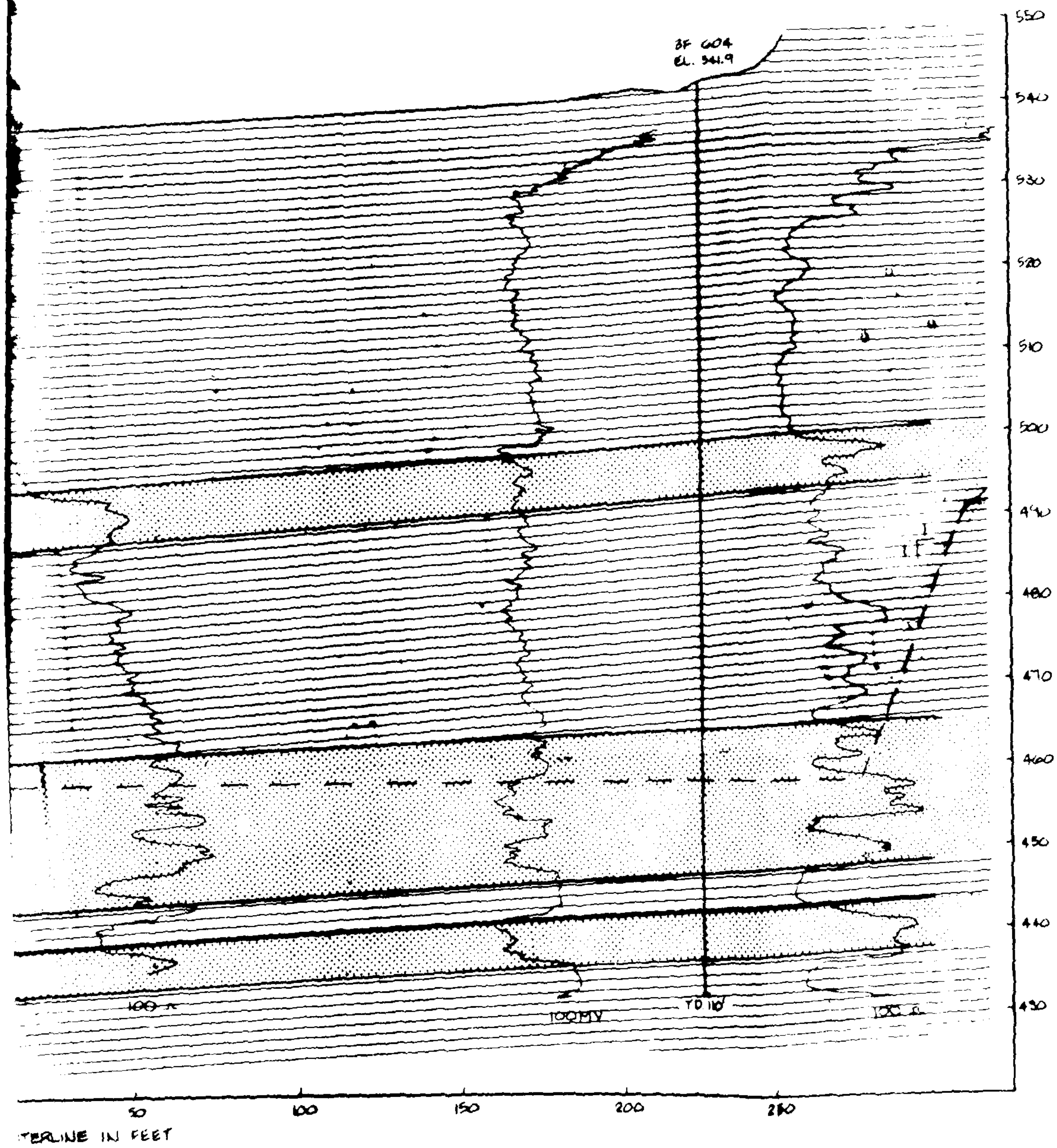
TO ACCOMPANY FINAL FOUNDATION REPORT



SPILLWAY SECTION B

STATION 15+50

SCALE: VERT
HORIZ.

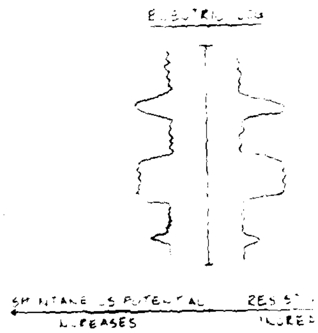


TERLINE IN FEET

B - B

LEGEND

WOODBINE FORMATION
(CRETACEOUS AGE)



SPONTANEOUS POTENTIAL INCREASES

RESIST... INCREA...

NOTES

1 FOR DETAILED LITHOLOGIC DESCRIPTIONS SEE LOGS OF BORINGS.

2 E-LOGGER SETTINGS ARE NOTED AT BOTTOM OF E-LOGS.

3 LOCATION OF SECTION B-B IS SHOWN ON PLATE 4

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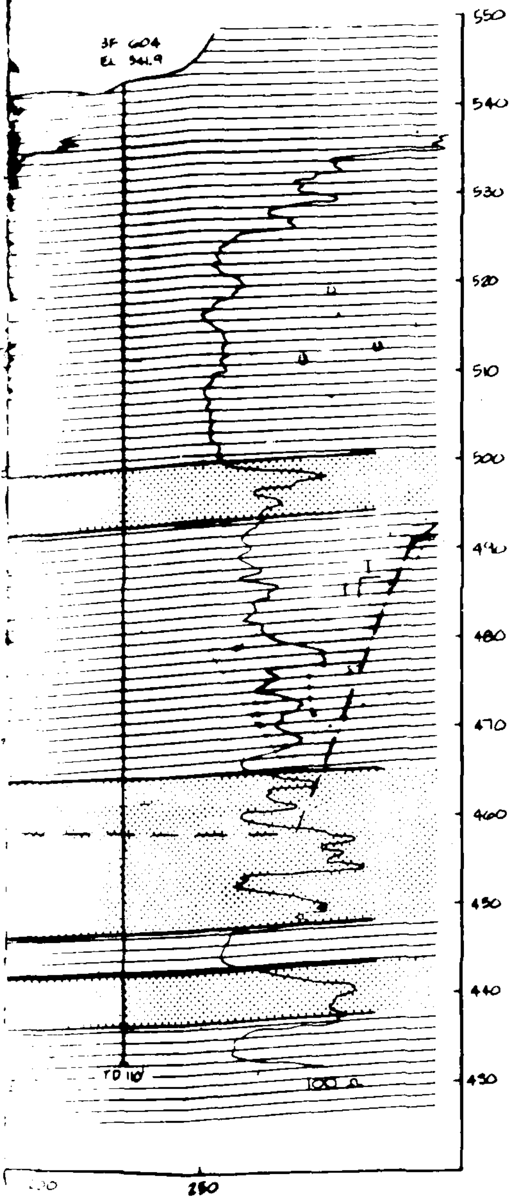
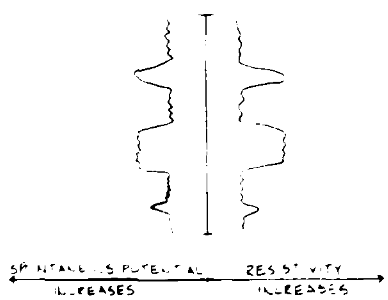


LEGEND

WOODBINE FORMATION (CRETACEOUS AGE)

- PREDOMINANTLY SANDSTONE W/ SHALE & SHALY SANDSTONE INTERBEDS.
- PREDOMINANTLY SHALE W/ SANDSTONE & SANDY SHALE INTERBEDS.

ELECTRIC LOG



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SYM	DG. NO.	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY A. MARR
DRAWN BY L. GOSS
REVIEWED BY M. GREEN
SUBMITTED BY MEL GREEN ENGINEER

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

MODIFICATION OF
EMBANKMENT AND SPILLWAY

SECTION B-B

INVITATION NO. DATE
CONTRACT NO.
DRAWING NUMBER SHEET NO.
PLATE 6

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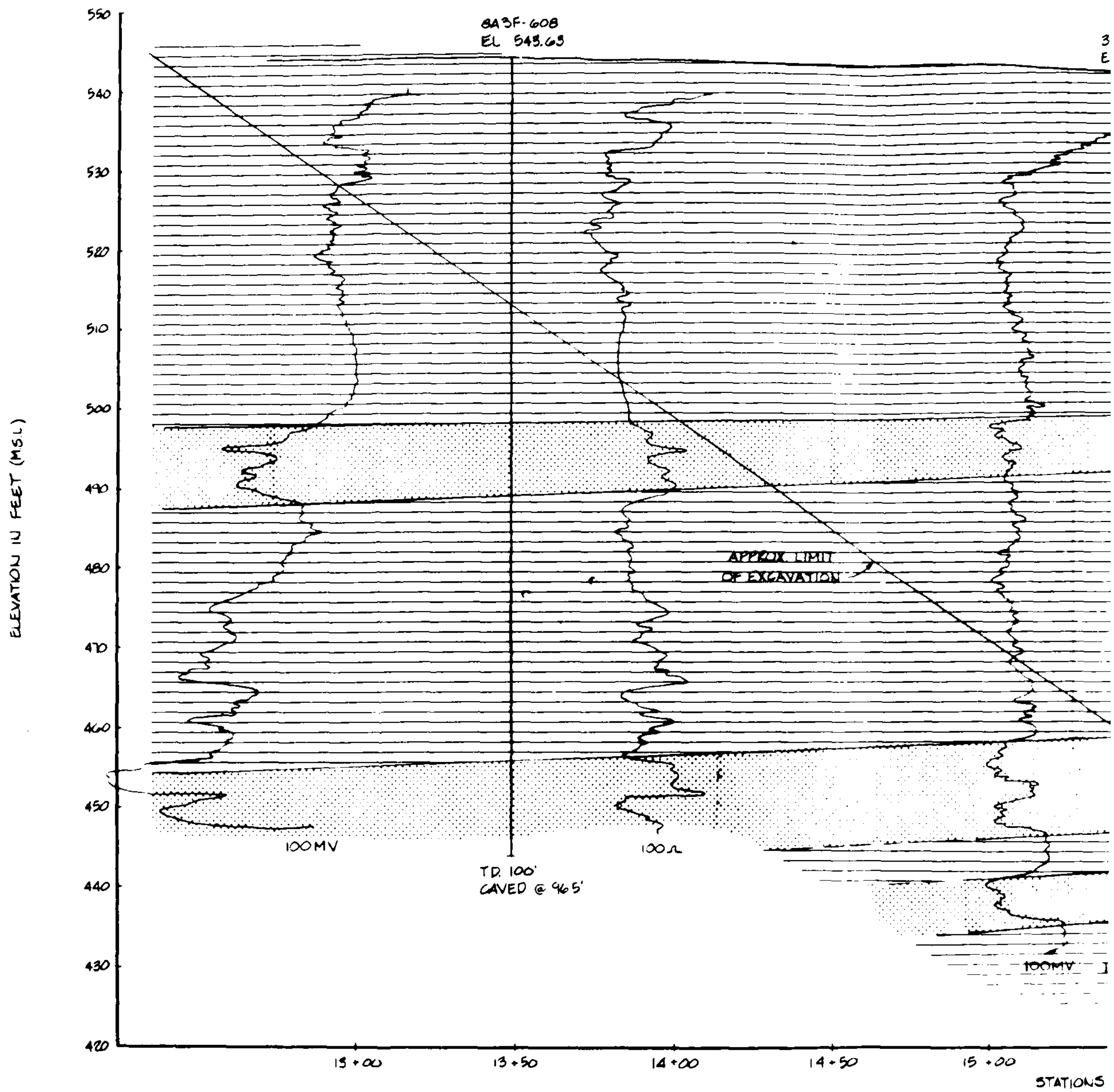
TO ACCOMPANY FINAL FOUNDATION REPORT



SPILLWAY SE

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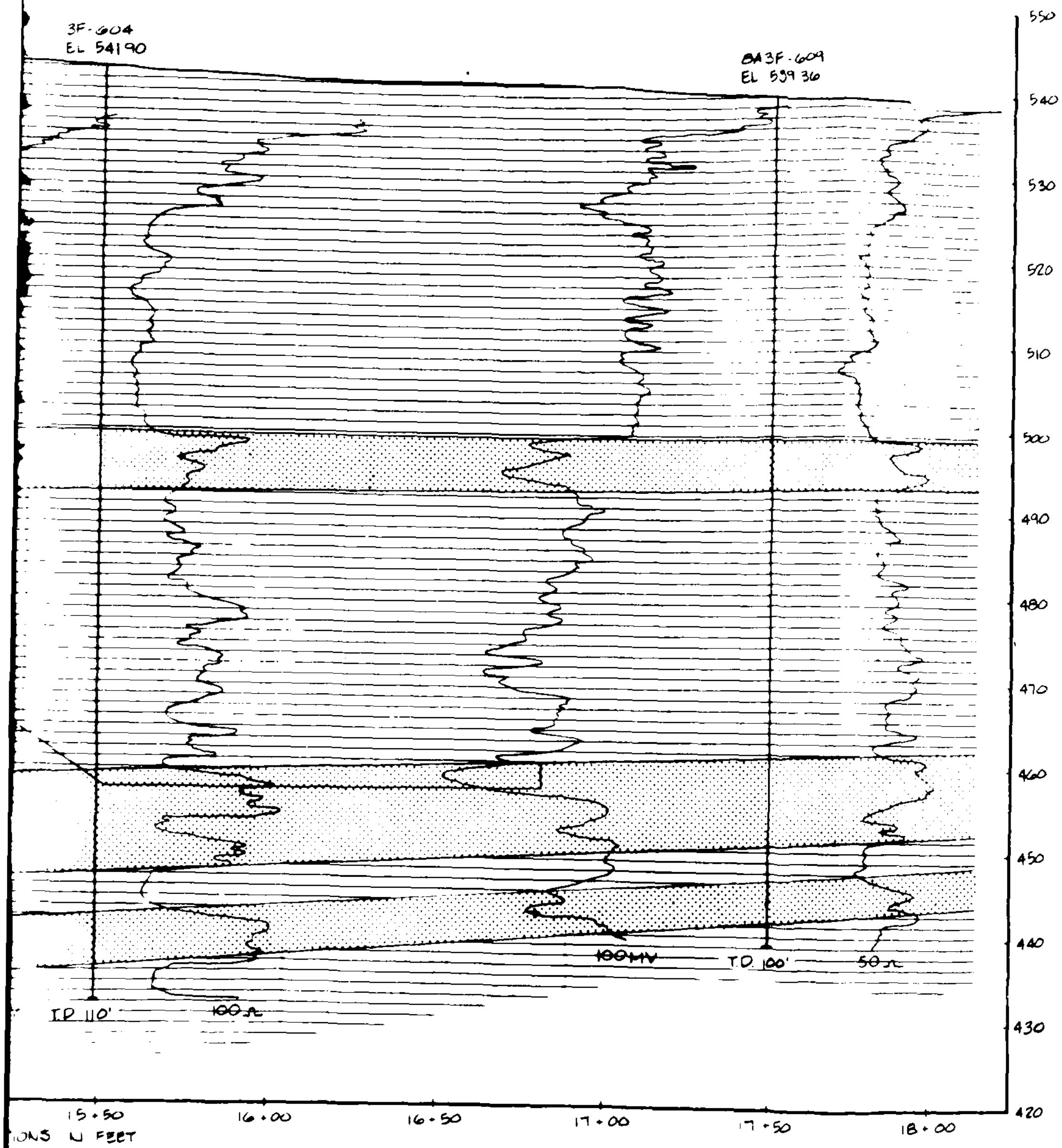


SECTION C-C

1. FOR LOCATION OF SECTION C-C SE
2. FOR LEGEND AND GENERAL NOTES

SYM.	DOC. NO.	ACTION	DATE

DESIGNED BY A. MARR

DRAWN BY L. GOSS

REVIEWED BY M. GREEN

SUBMITTED BY M. GREEN ENGINEER

GRAPE

MODIF

EMBANKMEN

SECT

INVITATION

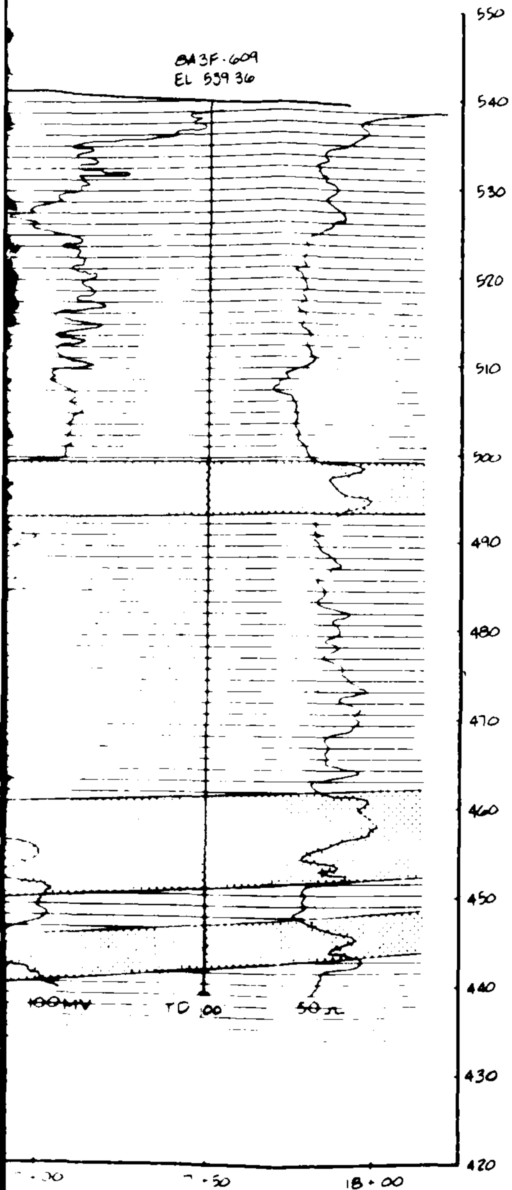
CONTRACT

DRAWING N

5 6 7 8

TO ACCOMPANY FINAL FOUNDATION RE

7 | 8 | 9 | 10



1 FOR LOCATION OF SECTION C-C SEE PLATE 4
2 FOR LEGEND AND GENERAL NOTES SEE PLATE 6

SYM	DO. NO.	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

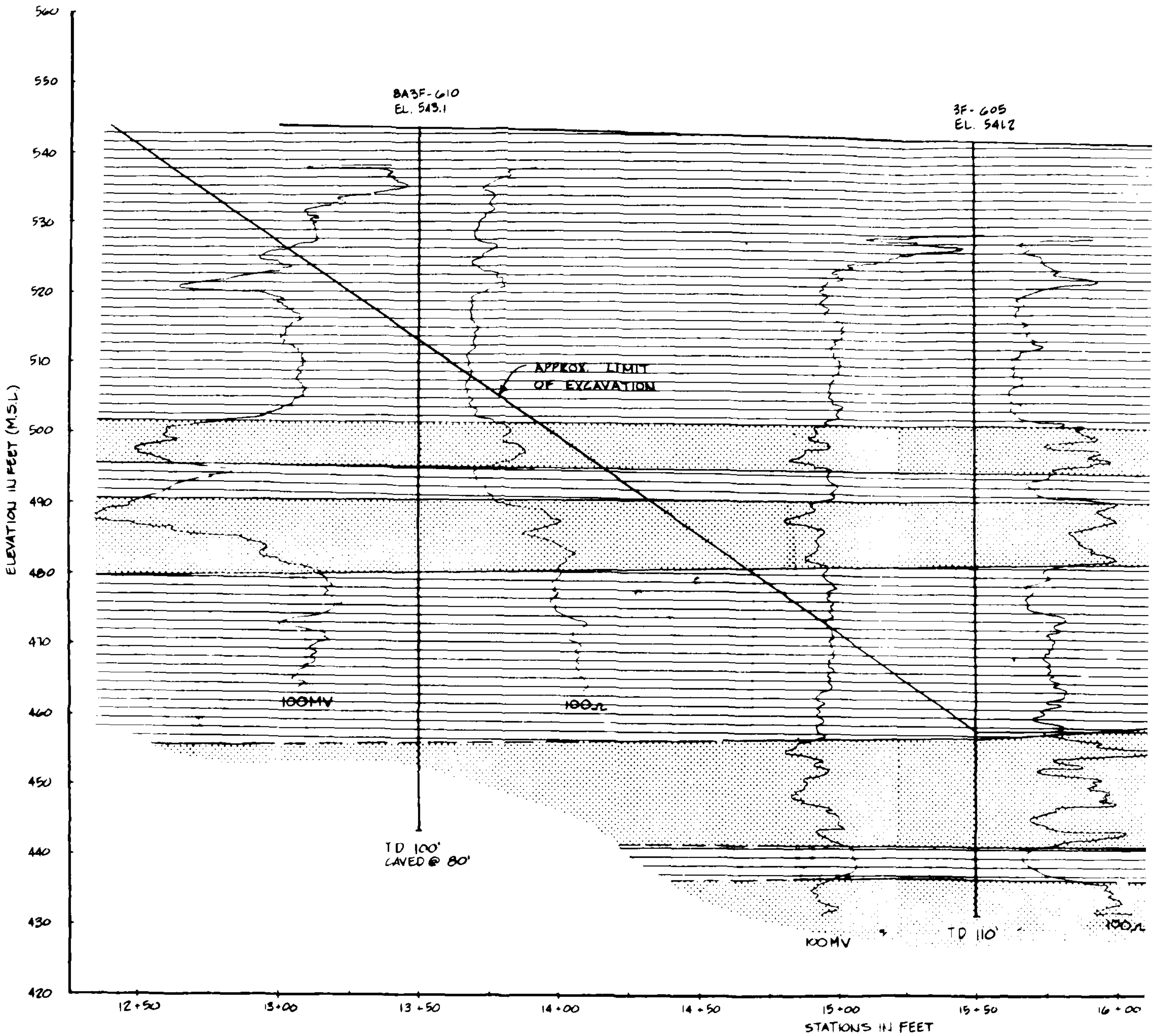
DESIGNED BY: A MARR
DRAWN BY: L GOSS
REVIEWED BY: M GREEN
SUBMITTED BY: M GREEN, ENGINEER

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS
MODIFICATION OF
EMBANKMENT AND SPILLWAY
3
SECTION C-C

INVITATION NO. | DATE
CONTRACT NO.
DRAWING NUMBER | SHEET NO.
PLATE 7

7 | 8

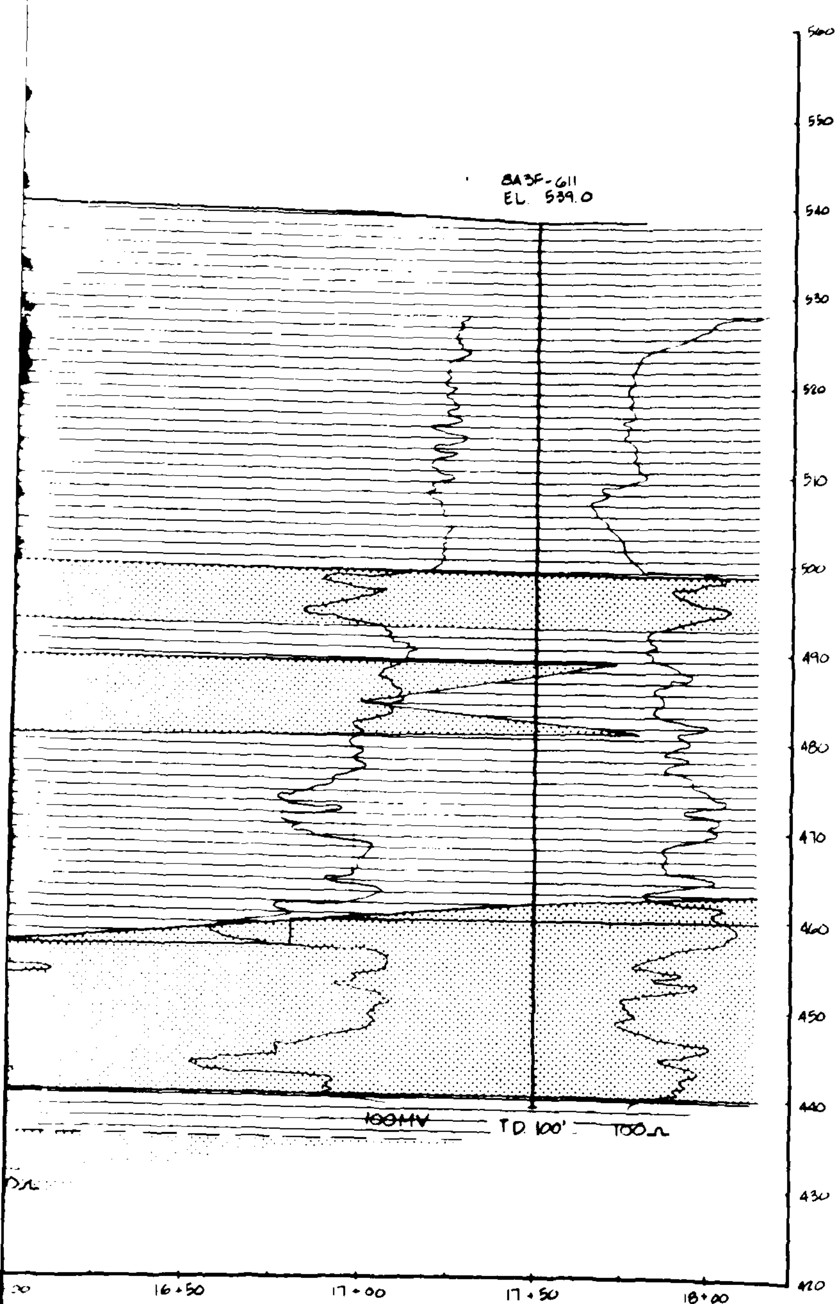
TO ACCOMPANY FINAL FOUNDATION REPORT



SPILLWAY SECTION D-D

SCALE VERT 1" = 10'-0"
HORIZ 1" = 25'-0"

5 6 7 8 9



NOTES:

1 FOR LOCATION OF SECTION D-D SEE PLATE
2 FOR LEGEND AND GENERAL NOTES SEE PL

SYM	DC NO.	ACTION	DATE	DESCR

U.S. ARMY E

DESIGNED BY A MARR

DRAWN BY L GOSS

REVIEWED BY M GREEN

SUBMITTED BY M GREEN ENGINEER

GRAPEVINE L

DENTON CREEK, ELM FORK, TRI

MODIFICATIO

EMBANKMENT AND

SECTION D

INVITATION NO.

CONTRACT NO.

DRAWING NUMBER

5 6 7 8

TO ACCOMPANY FINAL FOUNDATION REPORT

8 | 9 | 10

F

E

D

C

B

NOTES:

1 FOR LOCATION OF SECTION D-D SEE PLATE 4
2 FOR LEGEND AND GENERAL NOTES SEE PLATE 6

SYM.	DO. NO.	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: A MARR
DRAWN BY: L GOSS
REVIEWED BY: M GREEN
SUBMITTED BY: M GREEL, ENGINEER

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS
MODIFICATION OF
EMBANKMENT AND SPILLWAY

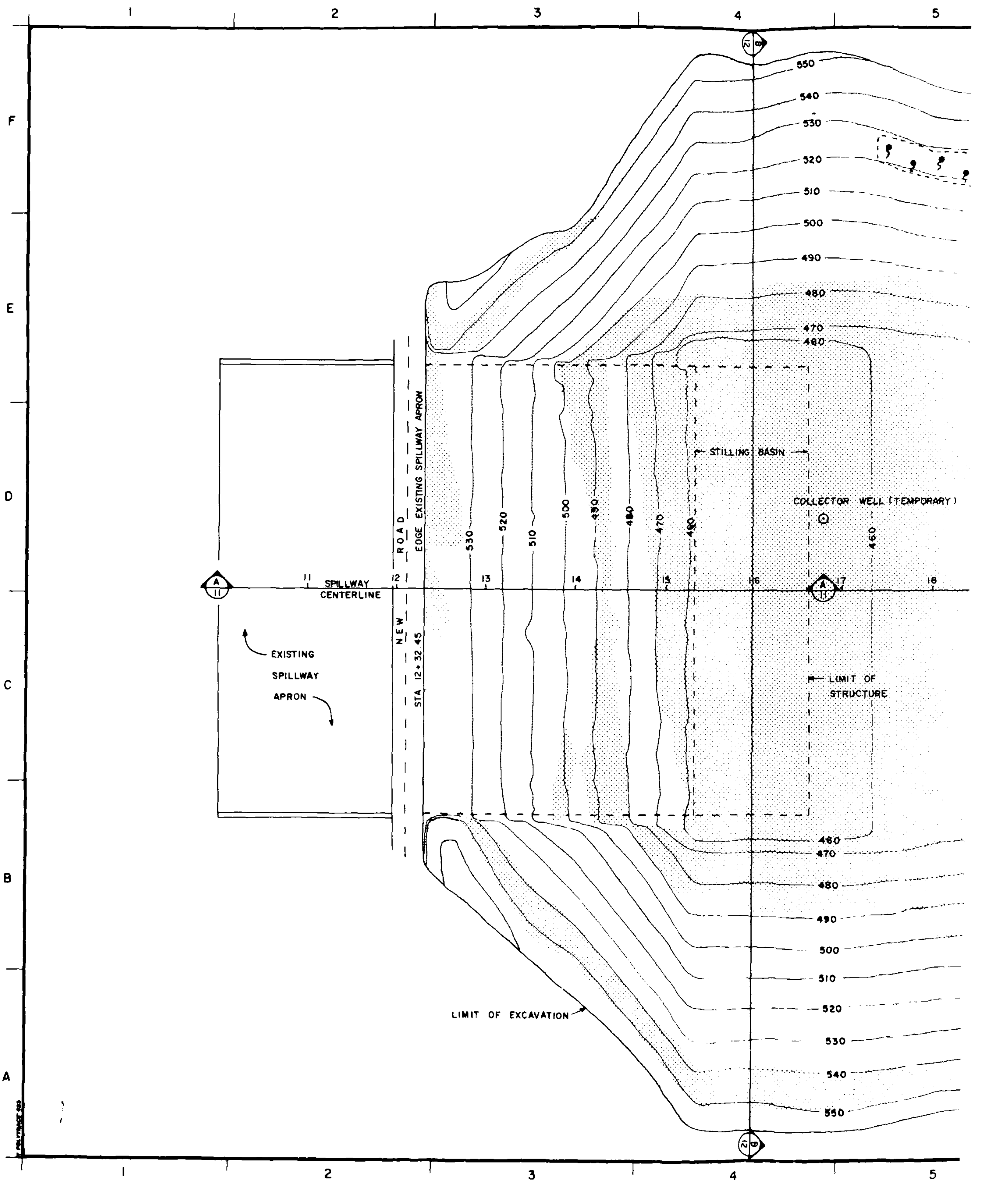
3

SECTION D-D

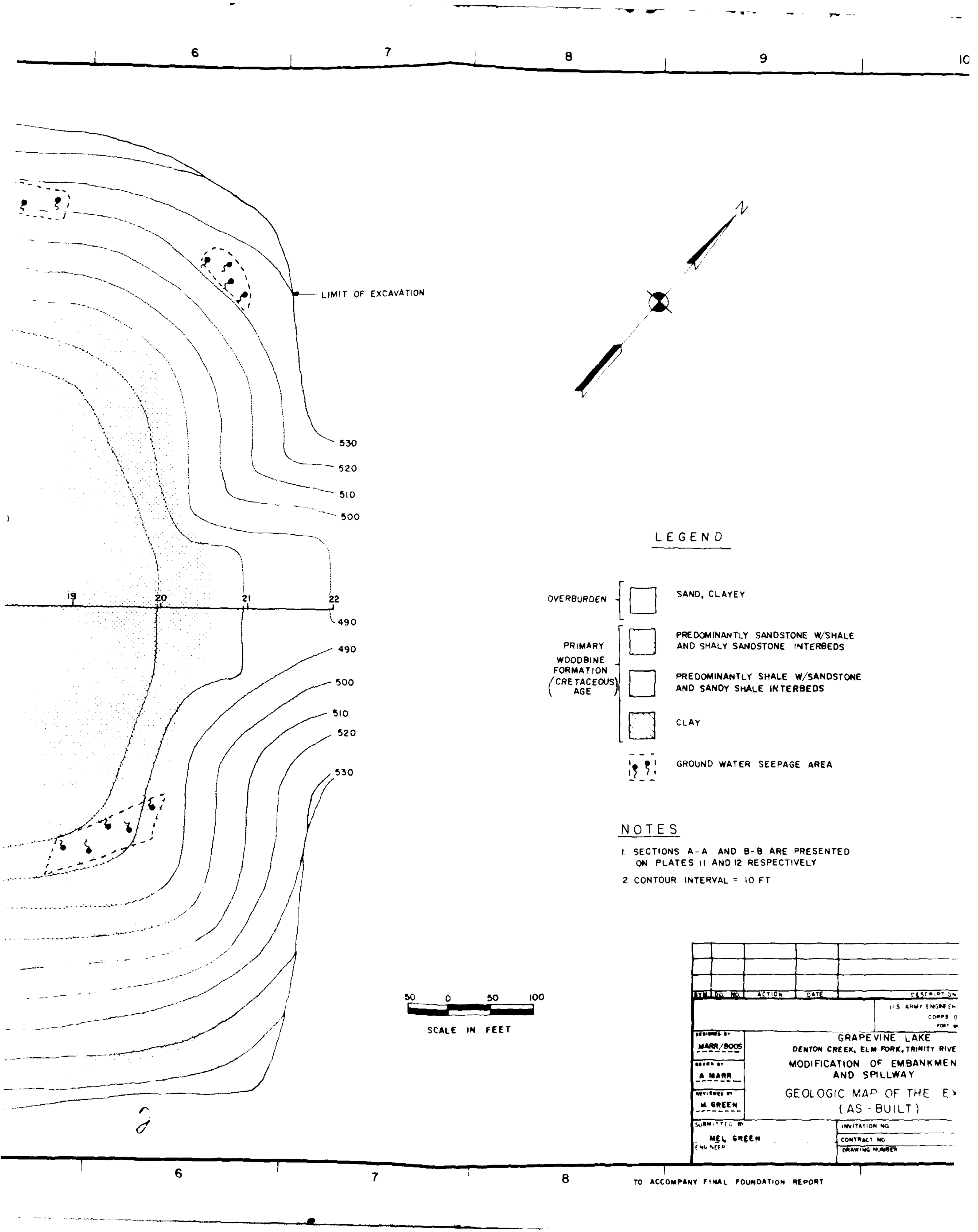
INVITATION NO. | DATE
CONTRACT NO.
DRAWING NUMBER | SHEET NO.
PLATE 8
CONTRACT NO.

8

TO ACCOMPANY FINAL FOUNDATION REPORT



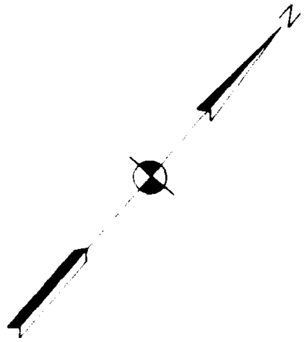
1 2 3 4 5
F E D C B A
550
540
530
520
510
500
490
480
470
460
STILLING BASIN
COLLECTOR WELL (TEMPORARY)
LIMIT OF STRUCTURE
SPILLWAY CENTERLINE
11 12 13 14 15 16 17 18
EXISTING SPILLWAY APRON
NEW ROAD
EDGE EXISTING SPILLWAY APRON
STA 12+32.45
LIMIT OF EXCAVATION



6
7
8
9
10
LIMIT OF EXCAVATION
530
520
510
500
19
20
21
22
490
490
500
510
520
530
N
LEGEND
OVERBURDEN
SAND, CLAYEY
PRIMARY
WOODBINE
FORMATION
(CRETACEOUS)
AGE
PREDOMINANTLY SANDSTONE W/SHALE
AND SHALY SANDSTONE INTERBEDS
PREDOMINANTLY SHALE W/SANDSTONE
AND SANDY SHALE INTERBEDS
CLAY
GROUND WATER SEEPAGE AREA
NOTES
1 SECTIONS A-A AND B-B ARE PRESENTED ON PLATES 11 AND 12 RESPECTIVELY
2 CONTOUR INTERVAL = 10 FT
50
0
50
100
SCALE IN FEET
SYM.
DG. NO.
ACTION
DATE
DESCRIPTION
DESIGNED BY
MARR/BOOS
DRAWN BY
A MARR
REVIEWED BY
M. GREEN
SUBMITTED BY
MEL GREEN
ENGINEER
GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVE
MODIFICATION OF EMBANKMEN
AND SPILLWAY
GEOLOGIC MAP OF THE E
(AS - BUILT)
INVITATION NO
CONTRACT NO
DRAWING NUMBER
6
7
8
TO ACCOMPANY FINAL FOUNDATION REPORT

8 9 10

F



E

D

LEGEND

OVERBURDEN
- SAND, CLAYEY

PRIMARY WOODBINE FORMATION (CRETACEOUS AGE)
- PREDOMINANTLY SANDSTONE W/SHALE AND SHALY SANDSTONE INTERBEDS
- PREDOMINANTLY SHALE W/SANDSTONE AND SANDY SHALE INTERBEDS
- CLAY

GROUND WATER SEEPAGE AREA

C

NOTES

1 SECTIONS A-A AND B-B ARE PRESENTED ON PLATES 11 AND 12 RESPECTIVELY

2 CONTOUR INTERVAL = 10 FT

B

50 100

E IN FEET

SYM	DO NO	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: MARR/BOOS
DRAWN BY: A MARR
REVIEWED BY: M. GREEN

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS
MODIFICATION OF EMBANKMENT AND SPILLWAY
GEOLOGIC MAP OF THE EXCAVATION
(AS-BUILT)

3

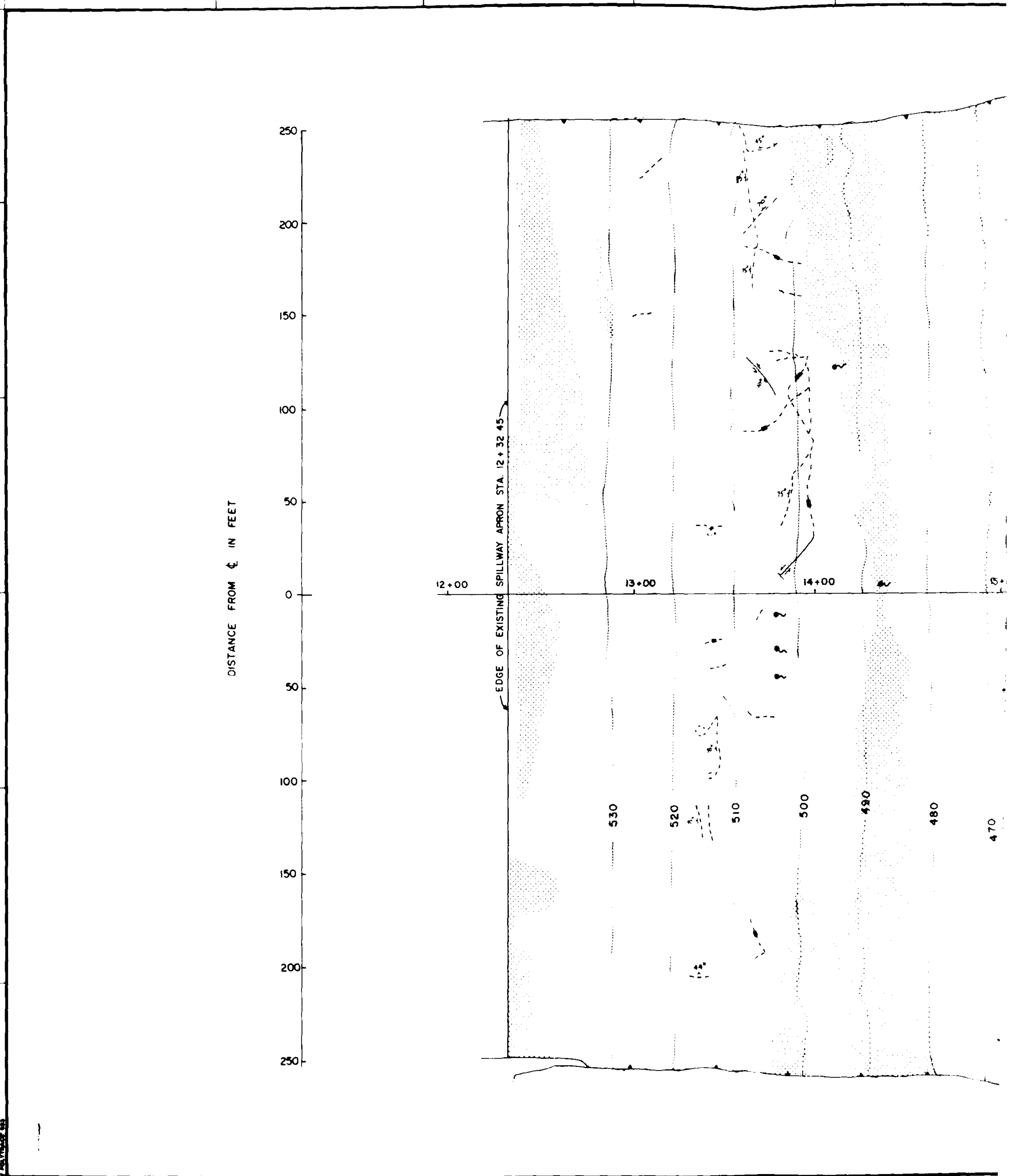
SUBMITTED BY: MEL GREEN, ENGINEER

INVITATION NO. | DATE
CONTRACT NO
DRAWING NUMBER | SHEET NO OF
PLATE 9

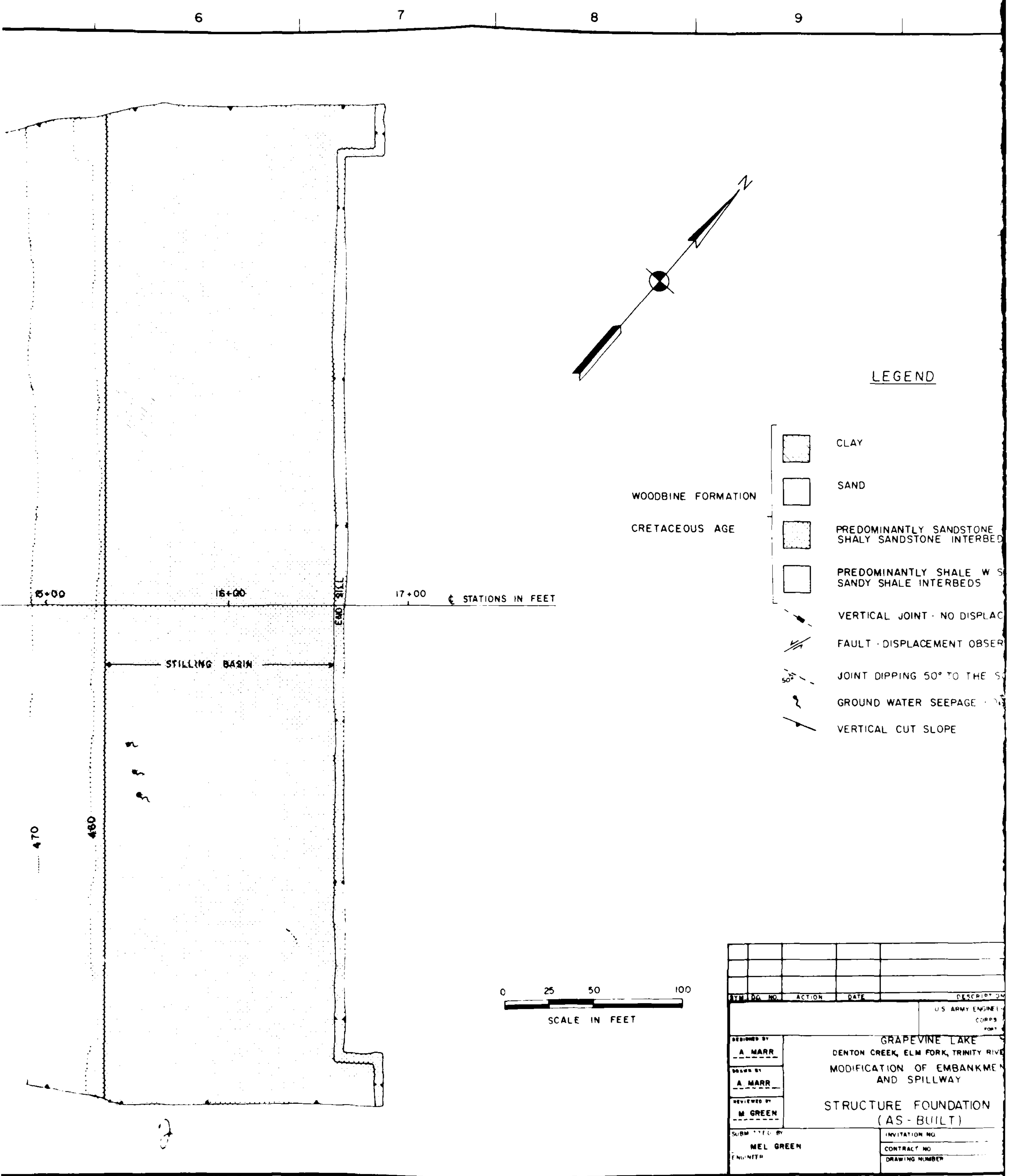
CONTRACT NO

8

TO ACCOMPANY FINAL FOUNDATION REPORT



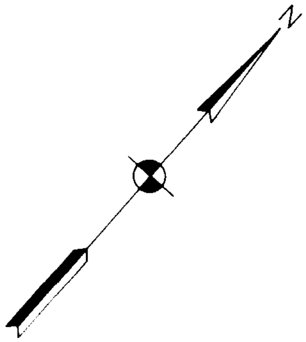
DISTANCE FROM ℄ IN FEET
EDGE OF EXISTING SPILLWAY APRON STA. 12 + 32.45
12+00
13+00
14+00
530
520
510
500
490
480
470
250
200
150
100
50
0
50
100
150
200
250



TO ACCOMPANY FINAL FOUNDATION REPORT

8 | 9 | 10

F



E

LEGEND

WOODBINE FORMATION

CRETACEOUS AGE

- CLAY
- SAND
- PREDOMINANTLY SANDSTONE W/SHALE AND SHALY SANDSTONE INTERBEDS
- PREDOMINANTLY SHALE W/SANDSTONE AND SANDY SHALE INTERBEDS
- VERTICAL JOINT · NO DISPLACEMENT
- FAULT · DISPLACEMENT OBSERVED
- JOINT DIPPING 50° TO THE SOUTHWEST
- GROUND WATER SEEPAGE POINT
- VERTICAL CUT SLOPE

D

℄ STATIONS IN FEET

C

B

0 25 50 100

SCALE IN FEET

SYM	DO NO	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY A. MARR
DRAWN BY A. MARR
REVIEWED BY M. GREEN

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS
MODIFICATION OF EMBANKMENT AND SPILLWAY

STRUCTURE FOUNDATION MAP
(AS - BUILT)

SUBMITTED BY MEL GREEN
ENGINEER

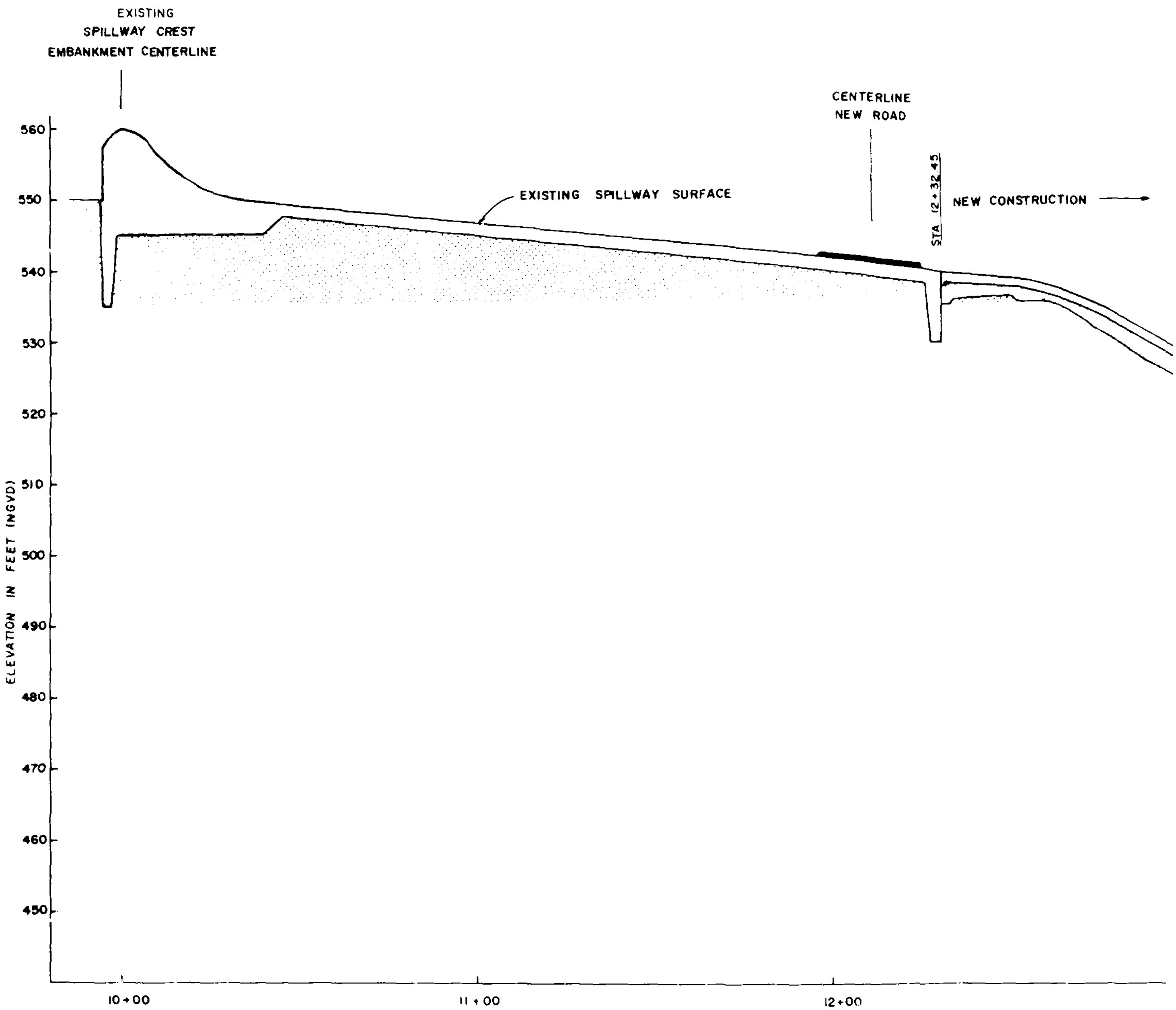
INVITATION NO | DATE
CONTRACT NO
DRAWING NUMBER | SHEET NO OF

PLATE 10

CONTRACT NO

8

TO ACCOMPANY FINAL FOUNDATION REPORT

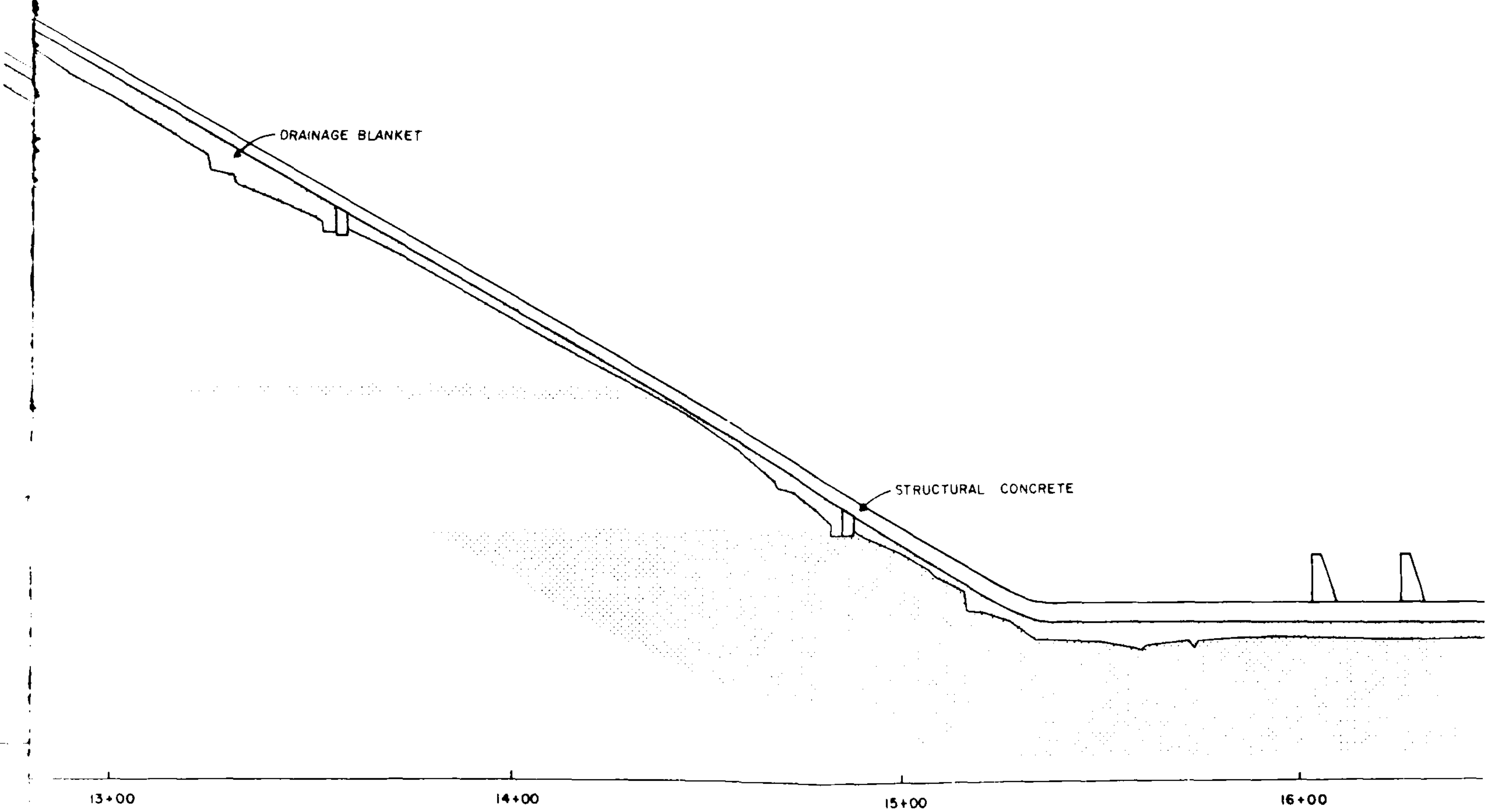


NOTES

1. FOR LOCATION OF CENTERLINE PROFILE A-A SEE PLATE 9
2. FOR LEGEND SEE PLATE 9

5 6 7 8 9

CENTERLINE PROFILE A-A



SPILLWAY STATIONS IN FEET

SYM.	DO. NO.	ACTION	DATE

DESIGNED BY A. MARR

DRAWN BY A. MARR

REVIEWED BY: M. GREEN

GRAPE

DENTON CREEK, EL

MODIFICATION
AND S

CENTERLIN
(AS

SUBMITTED BY MEL GREEN
ENGINEER

INVITATI

CONTRAC

DRAWING

7

5 6 7 8

TO ACCOMPANY FINAL FOUNDATION REPORT

8 9 10

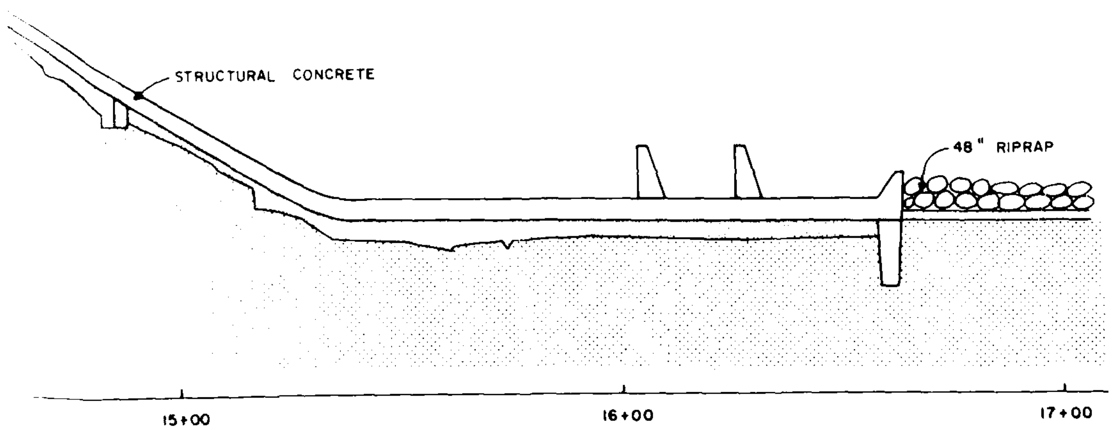
F

A - A

E

D

C



B

SYM.	DOC. NO.	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: A. MARR
DRAWN BY: A. MARR
REVIEWED BY: M. GREEN

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS
MODIFICATION OF EMBANKMENT AND SPILLWAY
CENTERLINE PROFILE A - A
(AS - BUILT)

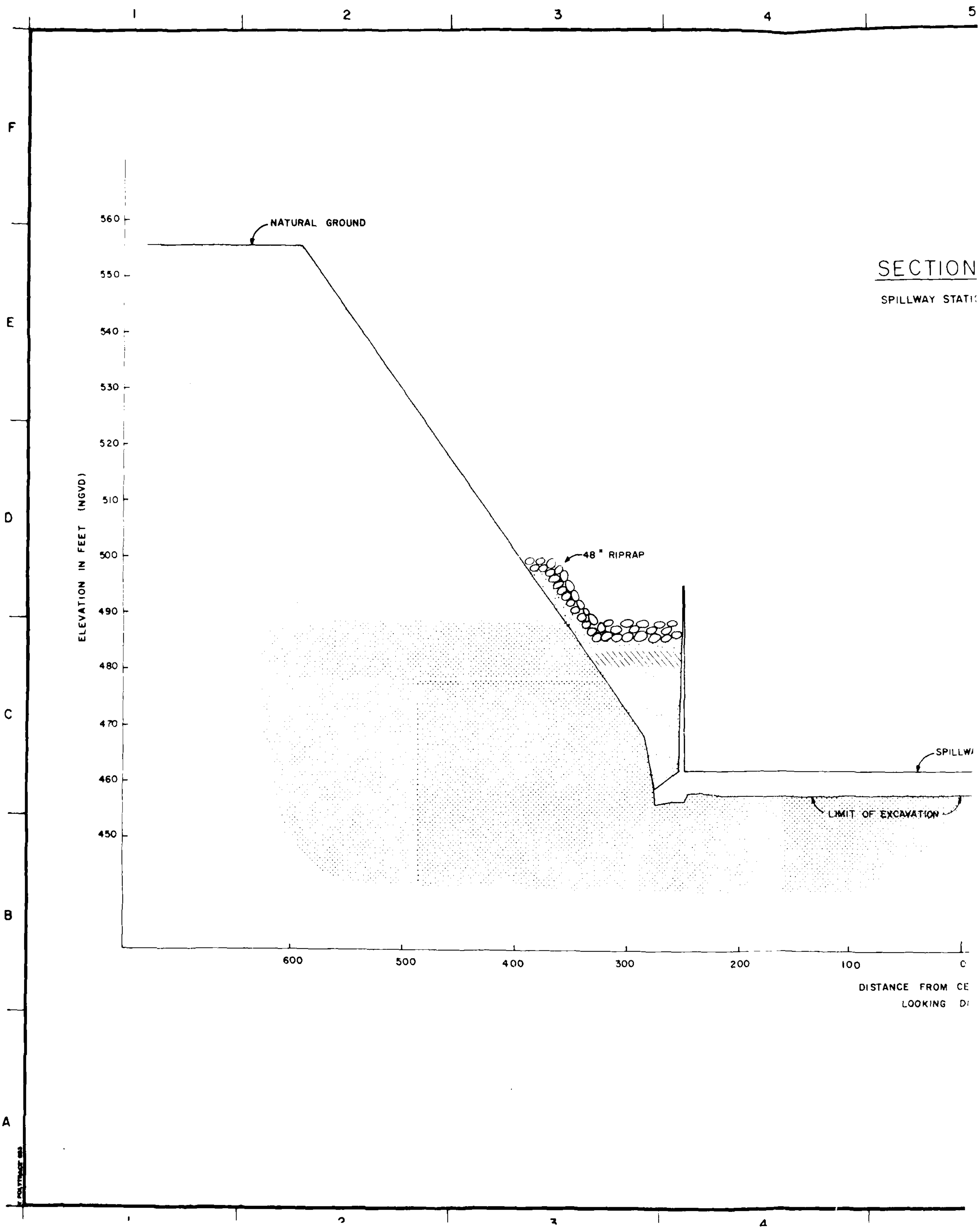
3

SUBMITTED BY: MEL GREEN
ENGINEER

INVITATION NO. | DATE
CONTRACT NO.
DRAWING NUMBER | SHEET NO. OF
PLATE 11
CONTRACT NO.

8

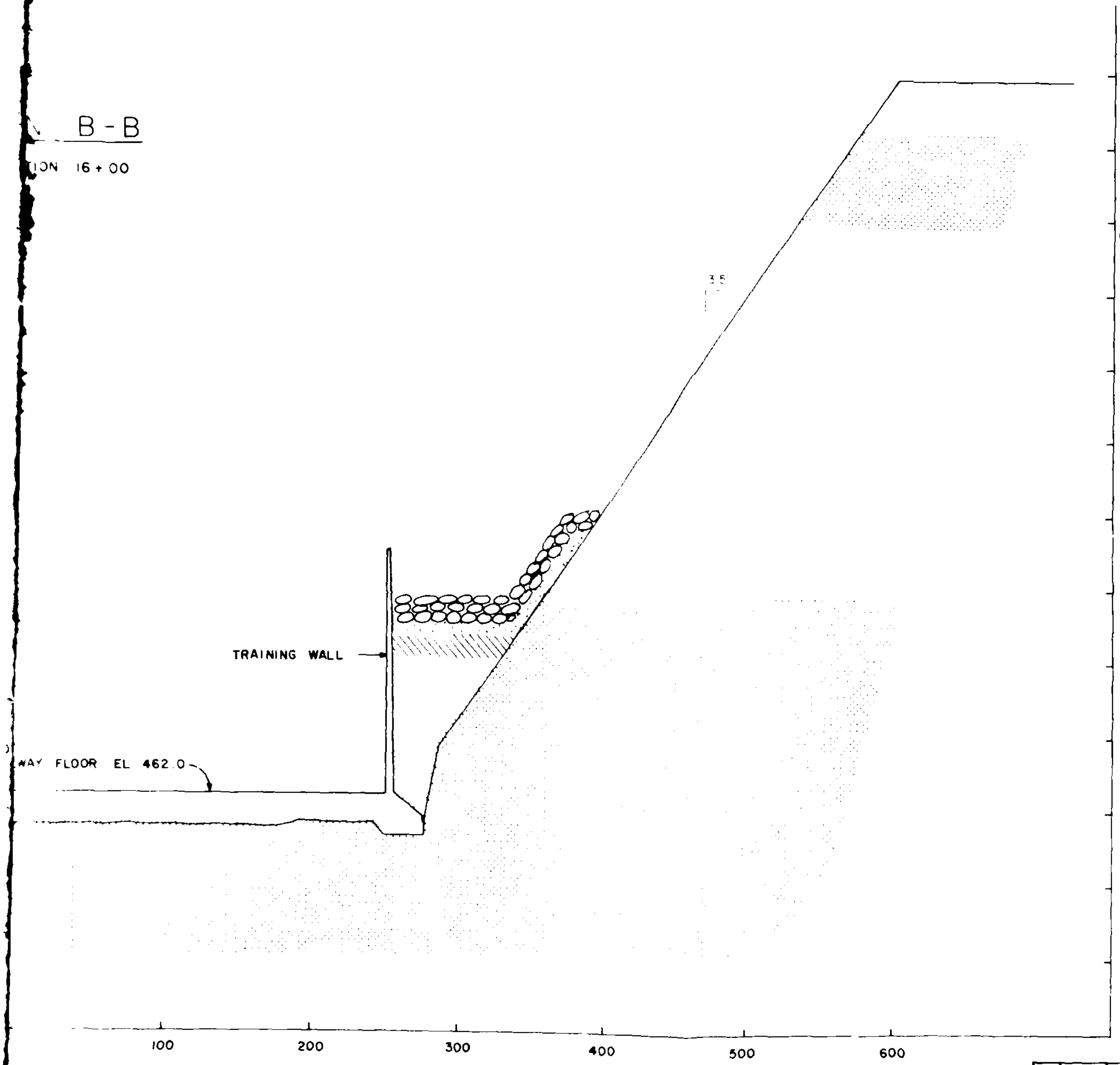
TO ACCOMPANY FINAL FOUNDATION REPORT



NATURAL GROUND
SECTION
SPILLWAY STAT
48" RIPRAP
SPILLW
LIMIT OF EXCAVATION
ELEVATION IN FEET (NGVD)
560
550
540
530
520
510
500
490
480
470
460
450
600
500
400
300
200
100
DISTANCE FROM CE
LOOKING D

B - B

ION 16 + 00



ENTERLINE IN FEET
WNSTREAM

LEGEND

OVERBURDEN
SAND, CLAYE

PRIMARY WOODBINE FORMATION (CRETACEOUS AGE)
PREDOMINANT AND SHALY S
PREDOMINANT AND SANDY

STRUCTURAL

NON-EXPANS

FILTER SAN

IMPERVIOUS

DRAINAGE B

NOTES

1. FOR LOCATION OF SECTION B-B SEE PLATE 9

SYM.	LOC. NO.	ACTION	DATE	DES

U.S. ARMY

DESIGNED BY A. MARR

DRAWN BY A. MARR

REVIEWED BY M. GREEN

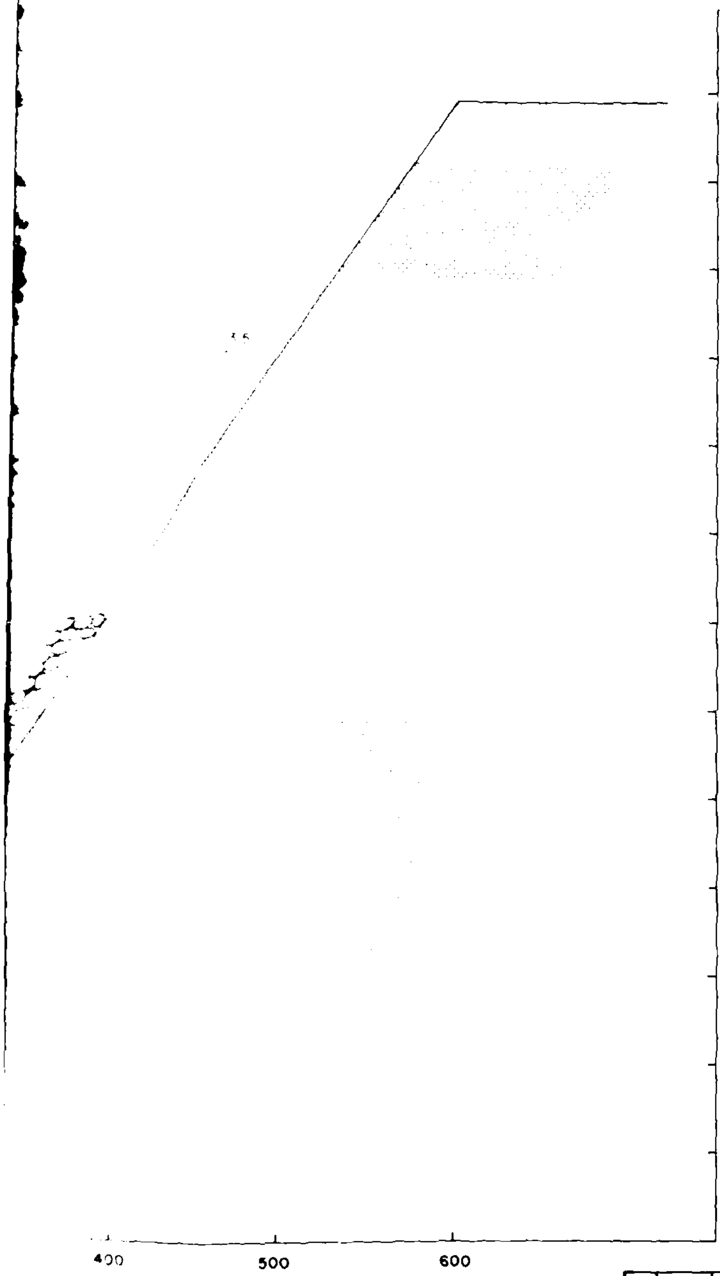
SUBMITTED BY MEL GREEN ENGINEER

GRAPEVINE LAK
DENTON CREEK, ELM FORK, TRIN
MODIFICATION OF EMBAN
AND SPILLWAY
SECTION B-
(AS-BUILT

INVITATION NO.
CONTRACT NO.
DRAWING NUMBER

TO ACCOMPANY FINAL FOUNDATION REPORT

7 8 9 10



LEGEND

OVERBURDEN		SAND, CLAYEY
PRIMARY WOODBINE FORMATION (CRETACEOUS AGE)		PREDOMINANTLY SANDSTONE W/SHALE AND SHALY SANDSTONE INTERBEDS
		PREDOMINANTLY SHALE W/SANDSTONE AND SANDY SHALE INTERBEDS
		STRUCTURAL CONCRETE
		NON-EXPANSIVE BACKFILL
		FILTER SAND
		IMPERVIOUS CLAY BACKFILL
		DRAINAGE BLANKET

N OF SECTION B-B SEE PLATE 9

SYM	DO. NO.	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: A. MARR
DRAWN BY: A. MARR
REVIEWED BY: M. GREEN

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS
MODIFICATION OF EMBANKMENT AND SPILLWAY

SECTION B-B
(AS-BUILT)

3

SUBMITTED BY: MEL GREEN, ENGINEER

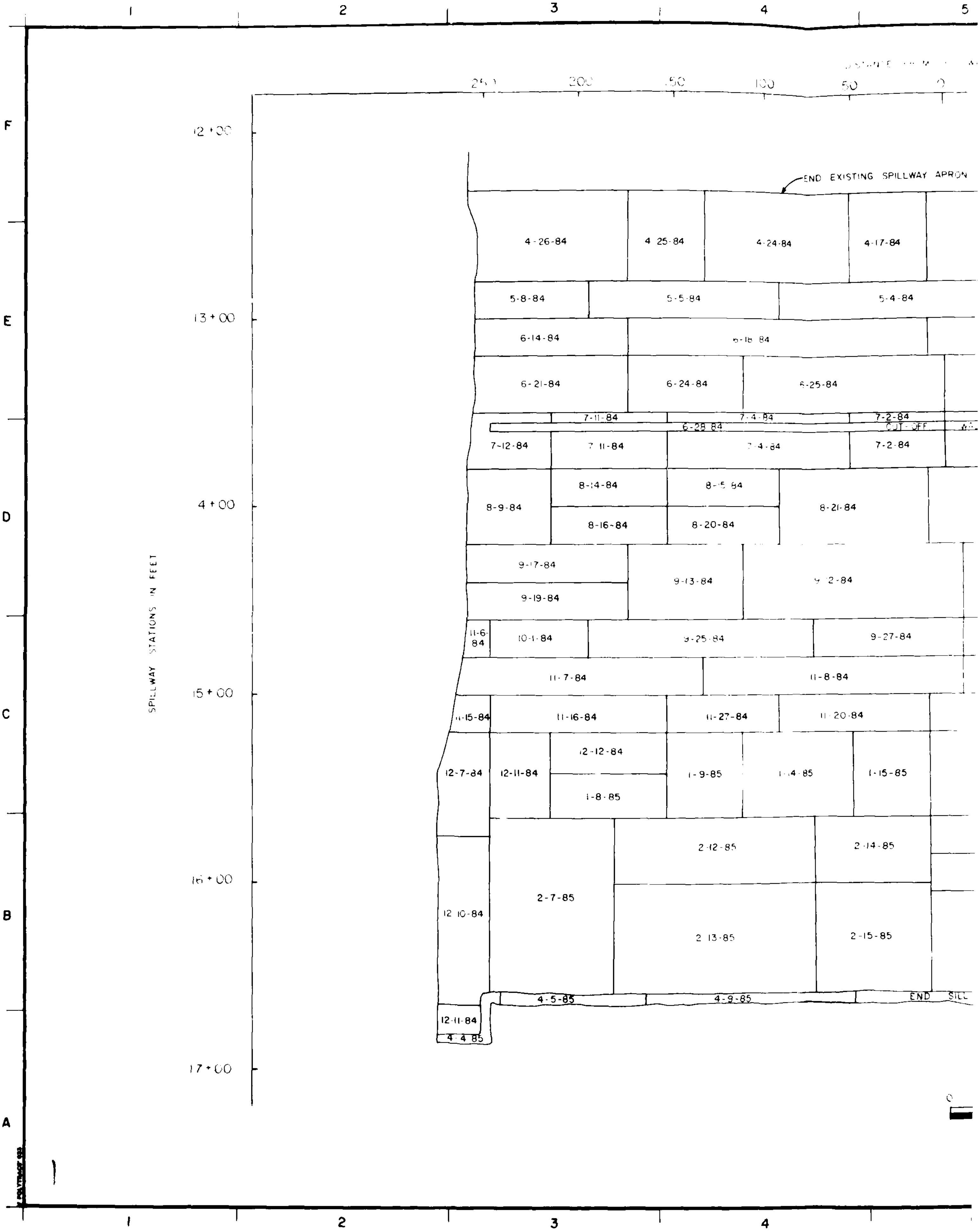
INVITATION NO. | DATE
CONTRACT NO.
DRAWING NUMBER | SHEET NO. OF

PLATE 12

CONTRACT NO.

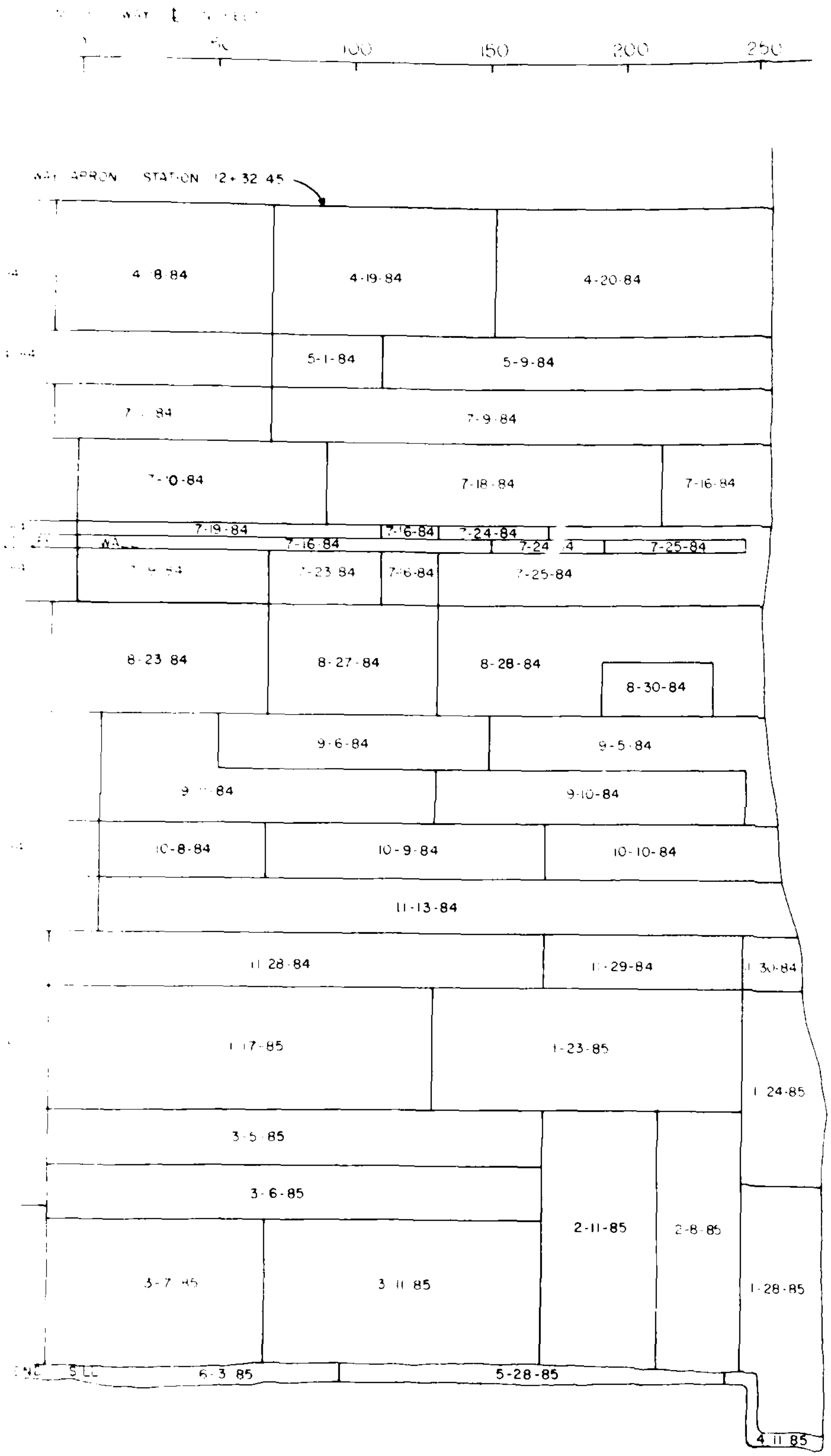
7 8

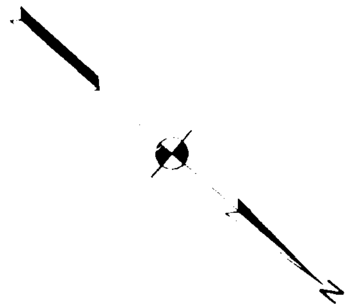
TO ACCOMPANY FINAL FOUNDATION REPORT

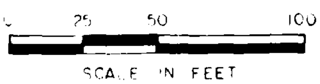


SPILLWAY STATIONS IN FEET
12+00
13+00
14+00
15+00
16+00
17+00
250
200
150
100
50
0
END EXISTING SPILLWAY APRON
4-26-84
4-25-84
4-24-84
4-17-84
5-8-84
5-5-84
5-4-84
6-14-84
6-18-84
6-21-84
6-24-84
6-25-84
7-11-84
7-4-84
7-2-84
6-28-84
CUT-OFF
7-12-84
7-11-84
7-4-84
7-2-84
8-14-84
8-5-84
8-9-84
8-21-84
8-16-84
8-20-84
9-17-84
9-13-84
9-2-84
9-19-84
11-6-84
10-1-84
9-25-84
9-27-84
11-7-84
11-8-84
11-15-84
11-16-84
11-27-84
11-20-84
12-12-84
12-7-84
12-11-84
1-9-85
1-4-85
1-15-85
1-8-85
2-12-85
2-14-85
2-7-85
12-10-84
2-13-85
2-15-85
4-5-85
4-9-85
END SILL
12-11-84
4-4-85

5 6 7 8 9







NOTES:

FOR GEOLOGIC MAP OF ...

2. EXCAVATION, APPROVAL, AND ... OCCURRED ON THE DATE SHOWN

SYM.	DO. NO.	ACTION	DATE

DESIGNED BY A. MARR

DRAWN BY A. MARR

REVIEWED BY: M. GREEN

SUBMITTED BY MEL GREEN ENGINEER

GRAPE...

DENTON CREEK, ELM...

MODIFICATION ... AND SP...

RECORD OF F...

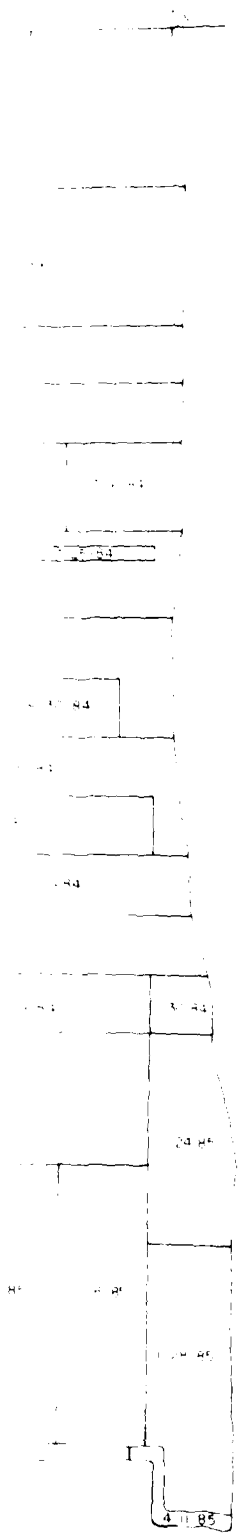
INVITATION ...

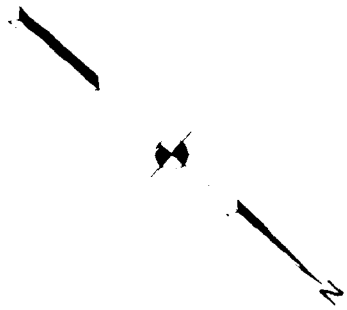
CONTRACT ...

DRAWING ...

5 6 7 8

TO ACCOMPANY FINAL FOUNDATION REPORT





NOTES:

1. FOR GEOLOGIC MAP OF FOUNDATION SEE PLATE 10
2. EXCAVATION, APPROVAL, AND BACKFILL ALL OCCURRED ON THE DATE SHOWN IN EACH AREA

SYM.	DO. NO.	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY A. MARR
DRAWN BY A. MARR
REVIEWED BY M. GREEN

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

MODIFICATION OF EMBANKMENT AND SPILLWAY

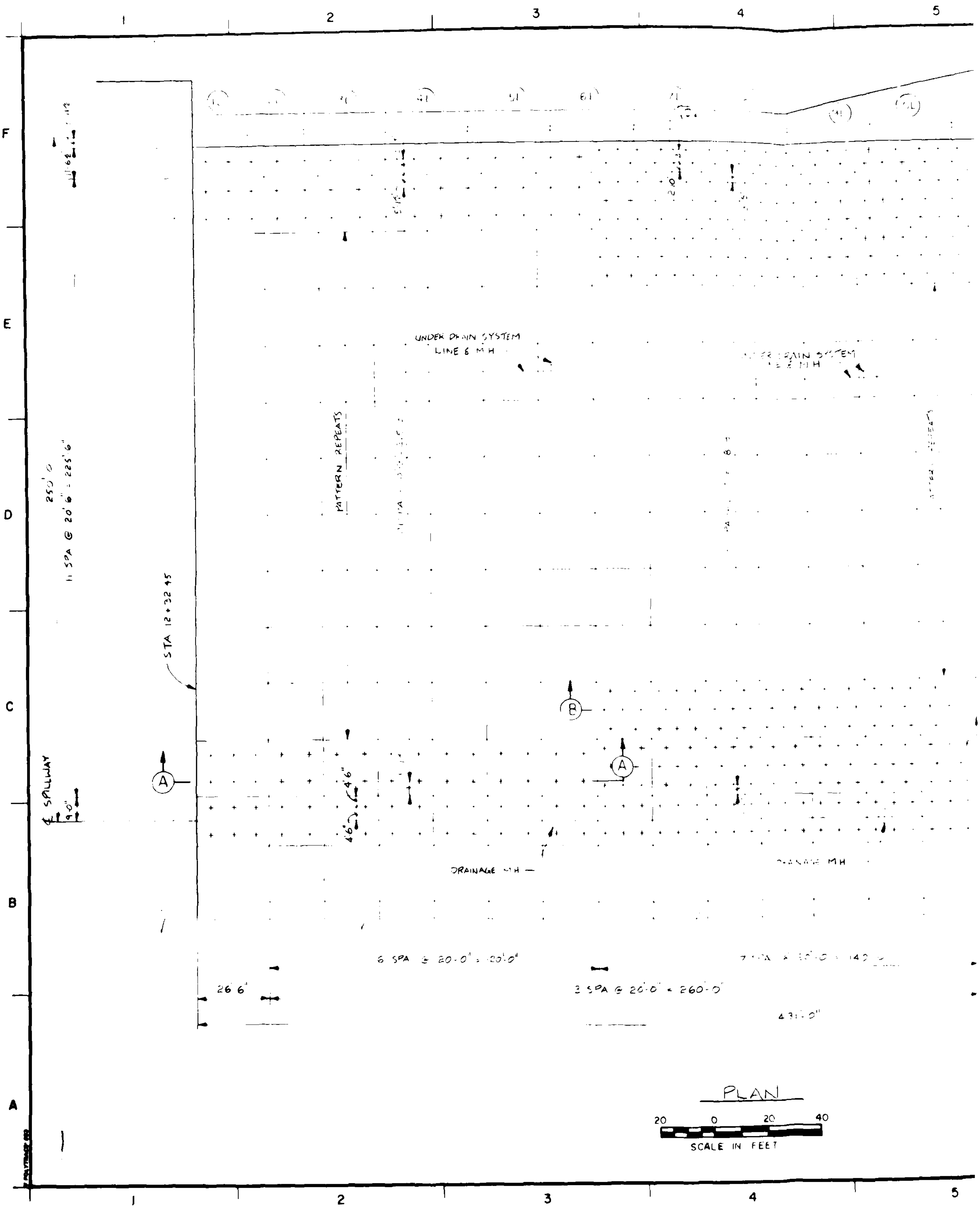
RECORD OF FOUNDATION APPROVAL

3

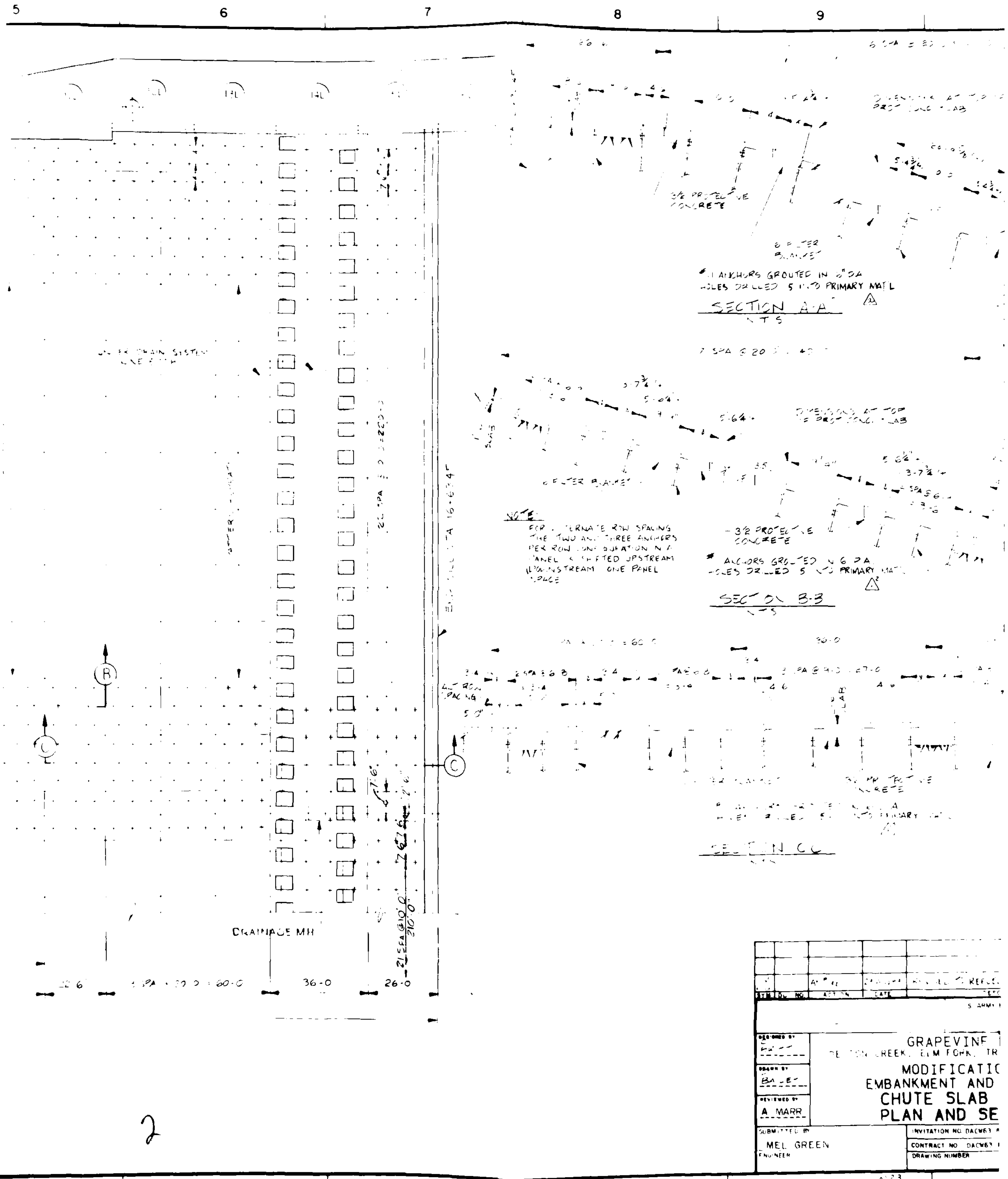
SUBMITTED BY MEL GREEN, ENGINEER

INVITATION NO. | DATE
CONTRACT NO.
DRAWING NUMBER | SHEET NO. OF | PLATE 13 | CONTRACT NO.

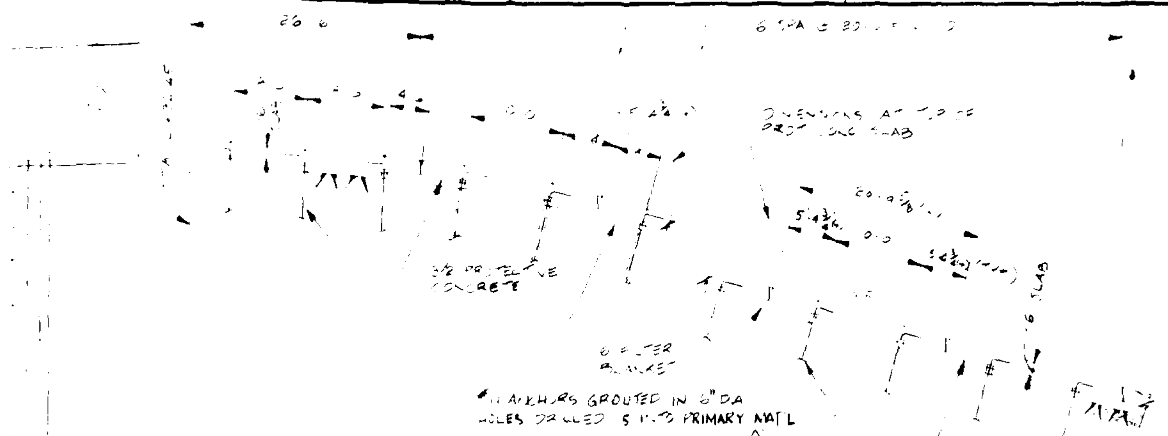
TO ACCOMPANY FINAL FOUNDATION REPORT



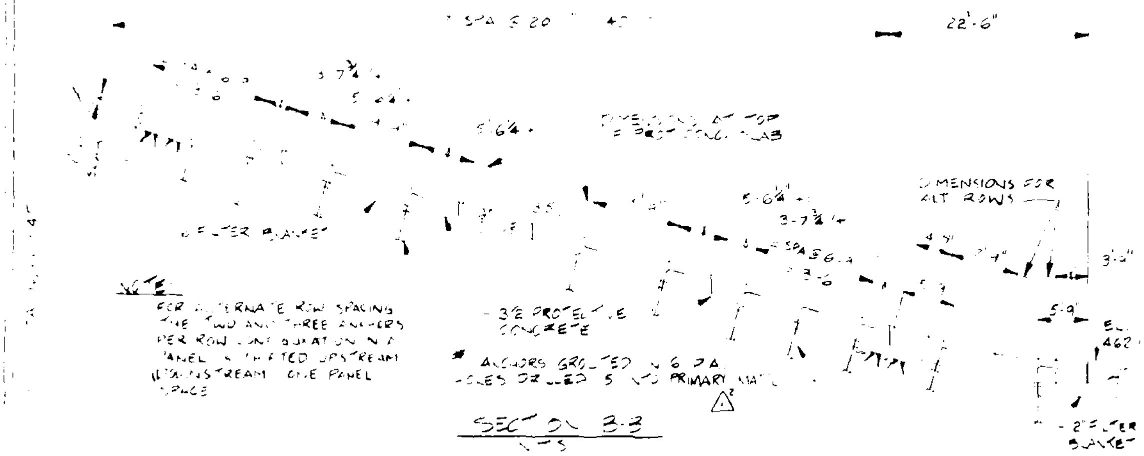
UNDER DRAIN SYSTEM
LINE 6 MH
PATTERN REPEATS
250'-0"
11 SPA @ 20'-6" = 225'-6"
STA 12+32.45
B
A
A
€ SPILLWAY
9'-0"
4'6"
4'6"
DRAINAGE MH
DRAINAGE MH
6 SPA @ 20-0' = 120'-0"
26'6"
3 SPA @ 20'-0" = 260'-0"
431'-0"
PLAN
20
0
20
40
SCALE IN FEET



TO ACCOMPANY FINAL FOUNDATION REPORT

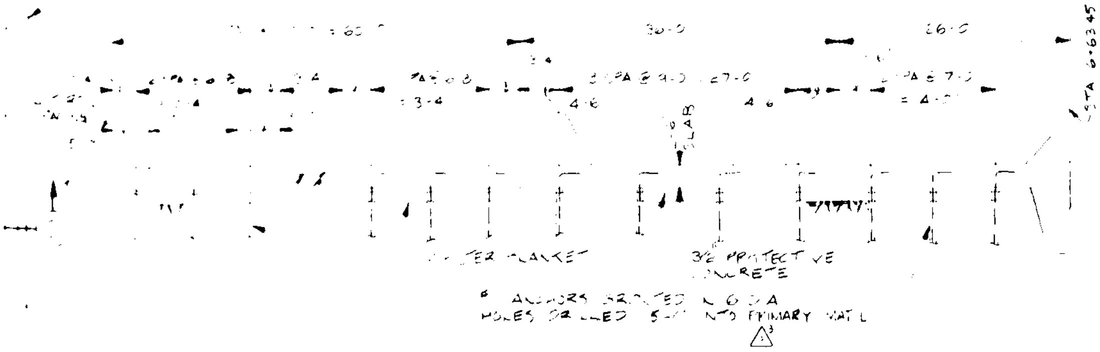


SECTION A-A
NTS



NOTE:
FOR ALTERNATE ROW SPACING THE TWO AND THREE ANCHORS PER ROW CONFIGURATION IN A PANEL IS SHIFTED UPSTREAM (DOWNSTREAM) ONE PANEL SPACE

SECTION B-B
NTS



SECTION C-C
NTS

SYM	DOC NO	ACTION	DATE	DESCRIPTION OF REVISION
2				REVISED TO REFLECT WRITE IN CHANGES

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY
DRAWN BY
REVIEWED BY: A. MARR
SUBMITTED BY: MEL GREEN, ENGINEER

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS
MODIFICATION OF EMBANKMENT AND SPILLWAY
CHUTE SLAB ANCHOR
PLAN AND SECTIONS

INVITATION NO. DACW63 83 B 0052 | DATE AUG 1983
CONTRACT NO. DACW63 83 C 0160
DRAWING NUMBER | SHEET NO OF | PLATE 14

CONTRACT NO. DACW63-83-C-0160

TO ACCOMPANY FINAL FOUNDATION REPORT

TES

BORING NO.	SAM. NO.	DEPTH OR ELEV. OF SAMPLE	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS GRAVEL %	SAND %	FINES %	D_{10}	ATTERBERG LIMITS LL	PL	SPECIFIC GRAVITY G	NAT WATER CONT %	NATURAL DRY DENSITY LBS/CU FT	COMPACTION DATA OPT WATER %	MAXIMUM DRY DENSITY LBS/CU FT	INITIAL e
															UNCON
8A6C-603		37.5-38.4	CLAY-SHALE	0	2	98		75	21	2.66	16.7				.444
(83/279)			W/SILT SEAMS												
8A6C-603		79.0-79.9	SILTSTONE							2.64	14.5				.323
(83/301)			ARGILLACEOUS												
8A6C 603		98.3-99.2	CLAY-SHALE	0	3	97		63	22	2.71	9.2				.384
(83/310)															
8A6C-603		105.2-106.1	SILTSTONE							2.71	8.3				.237
(83/312)															
														CONFINED	
8A6C-603		41.9-42.8	CLAY-SHALE	0	3	97		66	19	2.68	5.2				.410
(83/300)			W/SILT SEAMS												
8A6C-603		92.0-92.9	CLAY SHALE	1	8	91		46	18	2.67	12.4				.331
(83/307)			W/ SILTSTONE SEAMS												
8A6C-602		74.5-75.0	SILTSTONE								8.6				
(A-7106)			ARGILLACEOUS												

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DATA SUMMARY

SH

ECT GRAPEVINE SPILLWAY

SHEAR DATA											PERMEABILITY		CONSOLIDATION DATA			
Y DENSITY BS/CU FT	W_1 %	W_F %	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_m T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	e	K FT/MIN.	P_O T/SQ FT	P_C T/SQ FT	C_C	t_5
ED COMPRESSION TESTS																
115	16.7		100		5.5 X 10.7		0	15.4								
119	14.5		100		5.7 X 9.0		0	47.6								
122	14.2		100		5.2 X 9.4		0	2.2								
137	83		95		5.3 X 10.0		0	54.5								
OMPRESSION TEST (1-Pt Q)																
118	15.2		100		5.4 X 10.4		0.25	16.5								
125	12.4		[illegible]		5.5 X 10.3		0.25	12.5								
[illegible]	8.6				5.6 X 8.9		2.3	43.2								

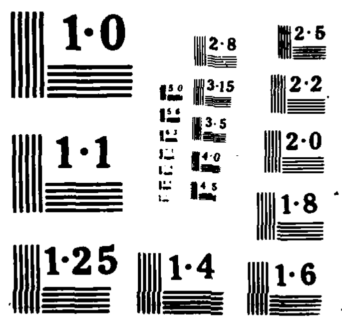
T – TRIAXIAL COMPRESSION
UC – UNCONFINED COMPRESSION
DS – DIRECT SHEAR
Q – UNCONSOLIDATED UNDRAINED
S
R

TO ACCOMPANY FINAL FOUNDATION REPORT

AD-A173 777 SPILLWAY MODIFICATION GRAPEVINE LAKE TEXAS(U) ARMY ENGINEER DISTRICT FORT WORTH TX A J MARR JUN 86 2/2

UNCLASSIFIED F/G 13/2 NL

END
1-87


1·0
2·8
2·5
3·15
2·2
3·5
2·0
1·1
4·0
1·8
1·25
1·4
1·6

SHEET ______ OF ______.

N SIZE HES	TEST	σ_m T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	PERMEABILITY e	PERMEABILITY K FT/MIN.	CONSOLIDATION DATA P_O T/SQ FT	CONSOLIDATION DATA P_C T/SQ FT	CONSOLIDATION DATA C_C	CONSOLIDATION DATA t_{50}	REMARKS
.7		0	15.4									
4.0		0	47.6									
[illegible]		0	2.2									
[illegible]		0	54.5									
[illegible]		0.25	16.5									
3		0.25	12.5									
[illegible]		2.3	43.2									

T - TRIAXIAL COMPRESSION
UC - UNCONFINED COMPRESSION
DS - DIRECT SHEAR
Q - UNCONSOLIDATED UNDRAINED
S - CONSOLIDATED DRAINED
R - CONSOLIDATED UNDRAINED

TI

BORING NO.	SAM. NO.	DEPTH OR ELEV. OF SAMPLE	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS GRAVEL %	SAND %	FINES %	D_{10}	ATTERBERG LIMITS LL	PL	SPECIFIC GRAVITY G	NAT WATER CONT %	NATURAL DRY DENSITY LBS/CU FT	COMPACTION DATA OPT WATER %	MAXIMUM DRY DENSITY LBS/CU FT	INIT e
SAGC-603		22.1-23.0	CLAY-SHALE	0	1	99		54	15	2.71	17.0				.5
(83/2[illegible])			W/ALTERNATING								17.3				.5
			LAYERS OF SILT								16.8				.5
											16.7				.4
SAGC-603		56.5-	CLAY-SHALE	0	0	100		49	15	2.65	10.7				.2
(83/303)		57.4	W/SILTSTONE SEAMS								10.8				.2
											10.8				[illegible]
											11.2				[illegible]
SAGC-603		63.5-	CLAY-SHALE	0	1	99		38	13	2.70	10.1				[illegible]
(83/304)		64.4	W/SILT SEAMS								9.9				[illegible]
											10.2				[illegible]
											10.0				[illegible]

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EST DATA SUMMARY

PROJECT GRAPEVINE SPILLWAY

TIAL	DRY DENSITY LBS/CU FT	W_1 %	W_F %	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_m T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	e	K FT/MIN	P_o T/SQ FT	P_c T/SQ FT
	SHEAR DATA											PERMEABILITY		CONSOLIDATI	
R-TRIAXIAL	COMPRE[illegible] TEST														
[illegible]	111	17.0		90		1.4 X 2.9		0.5	14.8[illegible]	3.5	33.7				
[illegible]	111	17.3		91		1.3 X 2.9		1.5	19.0						
[illegible]	112	16.8		90		1.4 X 3.0		3.0	24.1						
[illegible]	113	16.7		[illegible]		1.3 X 3.0		6.0	27.84						
[illegible]	129	10.7		99		1.4 X 3.0		0.5	9.11	2.4	25.0				
[illegible]	128	10.8		99		1.4 X 3.0		1.5	11.53						
[illegible]	[illegible]	10.9		98		1.4 X 3.0		3.0	15.61						
[illegible]	[illegible]	11.2		101		[illegible]		6.0	16.45						
[illegible]	[illegible]	[illegible]		[illegible]		1.3 X 2.[illegible]		0.5	[illegible]	3.7	28.0				
[illegible]	[illegible]	9.7		[illegible]		1.3 X [illegible]		1.5	[illegible]						
[illegible]	[illegible]	12.[illegible]		[illegible]		1.7 X 3.[illegible]		3.0	21.23						
[illegible]	[illegible]	10.0		[illegible]		[illegible]		6.0	21.41						

T - TRIAXIAL COMPRESSION

UC - UNCONFINED COMPRESSION

DS - DIRECT SHEAR

Q - UNCONSOLIDATED UNDRAINED

TO ACCOMPANY FINAL FOUNDATION REPORT

8

SHEET ________ OF ________

ST	σ_m T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	PERMEABILITY e	PERMEABILITY K FT/MIN	CONSOLIDATION DATA P_o T/SQ FT	CONSOLIDATION DATA P_c T/SQ FT	CONSOLIDATION DATA C_c	CONSOLIDATION DATA t_{50}	REMARKS
	0.5	[illegible]	3.5	33.7							
	[illegible]5	19.0									
	3.0	24.1									
	[illegible]	27.84									
	[illegible]	[illegible]	2.4	[illegible]							
	[illegible]	11.53									
	[illegible]	[illegible]									
	[illegible]	[illegible]									
	[illegible]	[illegible]	3.7	28.0							
	[illegible]	[illegible]									
	3.0	21.23									
	[illegible]	[illegible]									

TRIAXIAL COMPRESSION — DS — DIRECT SHEAR — S — CONSOLIDATED DRAINED

UNCONFINED COMPRESSION — Q — UNCONSOLIDATED UNDRAINED — R — CONSOLIDATED UNDRAINED

3

TE

BORING NO.	SAM. NO.	DEPTH OR ELEV. OF SAMPLE	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS GRAVEL %	SAND %	FINES %	D_{10}	ATTERBERG LIMITS LL	PI	SPECIFIC GRAVITY	[illegible]	NATURAL DRY DENSITY LBS/CU FT	COMPACTION DATA OPT WATER %	MAXIMUM DRY DENSITY LBS/CU FT	INITIAL e
															DIR
8A6C-603		22.1-	CLAY-SHALE	[illegible]	1	99		5[illegible]	[illegible]	[illegible]	[illegible]				.49[illegible]
(83/297)		23.0	W/ALTERNATING												.53[illegible]
			LAYERS OF SILT												.54[illegible]
8A6C-603		63.5	CLAY-SHALE	0	1	99		58	15	2.70	10.2				.3[illegible]
(83/304)		64.4	W/SILT SEAMS												.30[illegible]
															[illegible]
8A6C-603		73.8-	SILTSTONE							2.67	7.8				.218
(83/306)		74.7													.22[illegible]
															.22[illegible]
8A6C-603		103.6-	SILTSTONE							2.69	7.6				.17[illegible]
(83/311)		104.5													.16[illegible]
															.17[illegible]
															AE
8A6C-603		56.5-		0	0	100		49	15	2.65	12.3				.3[illegible]
(83/303)		57.4													.3[illegible]
															[illegible]

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'EST DATA SUMMARY

PROJECT Grapevine Spillway

	SHEAR DATA											PERMEABILITY		CONSOLIDATION	
T'AL e	DRY DENSITY LBS/CU FT	W_1 %	W_F %	S_1 %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_n T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	e	K FT/MIN	P_O T/SQ FT	P_C T/SQ FT
[illegible]ECT SHEAR TEST															
[illegible]	113	17.0	22.5	93		3.0 x 3.0		1.5							
[illegible]	110	17.2	21.5	89				3.0		0	35.0				
[illegible]	113	16.8	22.3	92				6.0							
[illegible]	131	9.6	11.7	92		3.0 x 3.0		[illegible]							
	139	9.4	13.0	84				[illegible]		1.2	27.0				
[illegible]	131	10.2	11.6	97				6.0							
[illegible]	[illegible]	7.6	9.9	[illegible]		3.0 x 3.0		[illegible]		[illegible]	[illegible]				
[illegible]	136	8.6	10.7	103				[illegible]							
[illegible]	136	9.1	9.6	96				[illegible]							
	[illegible]	6.1	10.1	91		3.0 x 1.0		[illegible]		0.5	[illegible]				
[illegible]	141	6.3	9.8	92				[illegible]							
[illegible]	142	6.1	8.0	92				6.0							
[illegible]ESIDUAL SHEAR TEST															
[illegible]	[illegible]	11.1	11.9	97				1.5		0	10.4				
[illegible]	128	10.9	13.8	[illegible]				3.0							
[illegible]	128	10.9	11.9	98				6.0							

T - TRIAXIAL COMPRESSION
UC - UNCONFINED COMPRESSION
DS - DIRECT SHEAR
Q - UNCONSOLIDATED UNDRAINED

7

TO ACCOMPANY FINAL FOUNDATION REPORT

SHEET ______ OF ______

EST	σ_3 T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	PERMEABILITY e	PERMEABILITY K FT/MIN.	CONSOLIDATION DATA P_O T/SQ FT	CONSOLIDATION DATA P_C T/SQ FT	CONSOLIDATION DATA C_C	CONSOLIDATION DATA t_{50}	REMARKS
	[illegible]5										
	[illegible]		0	35.0							
	[illegible]										
	[illegible]										
	[illegible]		1.2	29.0							
	[illegible]										
			[illegible]	[illegible]							
			0.5	[illegible]							
	[illegible]										
	[illegible]5		0	10.4							
	[illegible]										
	[illegible]										

TRIAXIAL COMPRESSION
UNCONFINED COMPRESSION

DS – DIRECT SHEAR
Q – UNCONSOLIDATED UNDRAINED

S – CONSOLIDATED DRAINED
R – CONSOLIDATED UNDRAINED

3

Hole No. 8AGC-602

DRILLING LOG	DIVISION: SWD	INSTALLATION: Ft Worth	SHEET 1 OF 2 SHEETS

1. PROJECT	Grapevine Lake
2. LOCATION (Coordinates or Station)	Spillway
3. DRILLING AGENCY	USCE
4. HOLE NO. (As shown on drawing title and file number)	8AGC-602
5. NAME OF DRILLER	Newhouse
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	0.0
8. DEPTH DRILLED INTO ROCK	75.7
9. TOTAL DEPTH OF HOLE	75.7
10. SIZE AND TYPE OF BIT	*
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: — UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	***
16. DATE HOLE	STARTED: 19 Dec 81 COMPLETED: 23 Dec 81
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Robert A McVey Jr

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			0.0 to 6.8 SHALE 0.0 to 3.0 - highly weathered to a med stiff clay consistency, moist, dark brn to yellow brn, silty. 3.0 to 6.8 - no apparent weathering, dark gray, dry, massive, mod soft(rx class).		A B drag bit	*Drilling 0.0 to 3.5' - 8" auger Refusal - 3.5 to 6.0' - 8" dragbit Set 3.0' csng 6.0 to [illegible] - dragbit [illegible] to 75.7' 6" carbon core *** hole bailed 18 hr ck @ 2.8'.
	10'		6.8 to 9.3 SANDSTONE - fine grained, dark gray, weakly to mod. cemented, massive, silty, mod soft(rx class).		Box 1	Jars A. 0.0 to 3.0 B. 3.0 to 3.5 refusal C. @ 3.6'
			9.3 to 19.1 SHALE - non weathered, dark gray to brn gray, soft to mod soft(rx class), silty, non calc, few scattered brn and hard concretions, thin (less than 0.05' thick) sandy/silty seams, very thin lignite seams scattered, hard black tar seam, fossils.		2 3	Carbon from 74.1 to 75'
	20'		19.1 to 22.4 SILTSTONE - shaley, sl sandy, massive, mod hard to hard, mod to well cemented, non calc, lt gray to dark gray.		4	
	30		22.4 to 56.4 SHALE - non weathered, non calc, mod soft, dark gray to brownish gray, silty, gray to lt gray from 55.3 to 56.4', numerous very thin silt/sand seams scattered throughout, hard, well cemented calc seam(0.1' thick) @ 33.4', few hard brn concretions. Unhealed fractures at 40.1'(45°) and 56 to 56.3'.		5 6 7	
	40					

6 7 8

Hole No.

DRILLING LOG	DIVISION SWD	INSTALLATION Ft Worth

1. PROJECT: Grapevine Lake
2. LOCATION: Spillway
3. DRILLING AGENCY:
4. HOLE NO. (As shown on drawing title and file number): 8A6C-602
5. NAME OF DRILLER:
6. DIRECTION OF HOLE: [ ] VERTICAL [ ] INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE
10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
12. MANUFACTURER'S DESIGNATION OF DRILL
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER
16. DATE HOLE STARTED COMPLETED
17. ELEVATION TOP OF HOLE
18. TOTAL CORE RECOVERY FOR BORING
19. SIGNATURE OF INSPECTOR

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS
			56.4 to 57.4		7	
			SILTSTONE - hard, massive, mod to well cemented, white and lt gray, shaley.		8	
			57.4 to 70.1			
			SHALE - as shale above except numerous sections of very sandy/silty friable thin seams, mod hard after 60', unhealed fracture @ 59.3 to 59.7'(30°), soft at 65.3' and 65.7'(both less than 0.1' thick)		9	
	50				10	
			70.1 to 75.7			
			SILTSTONE - mod hard/hard, mod cemented, massive, lt. gray to white, some olive gray, shaley, a gray and clean silt section from 70.9 to 71.2, sl. sandy after 74'.		11	
	60				12	
					13	
	70				14	
					15	

FOR LOCATION OF BORING SEE PLATE 4

A. MARR	GRAPEVINE
A. MARR	MODIFICATION EMBANKMENT AND
M. GREEN	LOG OF BORING
MEL GREEN	

5 6 7 8

FOR LOCATION OF BORING SEE PLATE 4

A. MARR

A. MARR

M. GREEN

GRAPEVINE LAKE

MODIFICATION OF
EMBANKMENT AND SPILLWAY

LOG OF BORING 8ABC-602

DACW63 83 B 0052 AUG 1983

MEL GREEN

DACW63 83 C 0160

PLATE 18

DACW63-83-C-0160

Hole No. BA6C-603

DRILLING LOG

DIVISION	SWD
INSTALLATION	FWD
SHEET	1 OF 3 SHEETS
1. PROJECT	GRAPEVINE LAKE
2. LOCATION	SPILLWAY
3. DRILLING AGENCY	USCE
4. HOLE NO. (As shown on drawing title and file number)	BA6C-603
5. NAME OF DRILLER	BREWER
6. DIRECTION OF HOLE	X VERTICAL ☐ INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	0
8. DEPTH DRILLED INTO ROCK	108.5'
9. TOTAL DEPTH OF HOLE	108.5'
10. SIZE AND TYPE OF BIT	8" AUGER 6" CORE BBL
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 19
14. TOTAL NUMBER CORE BOXES	19
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 11 FEB 83 / COMPLETED 15 FEB 83
17. ELEVATION TOP OF HOLE	538.0
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Allen Mar

ELEVATION (a) | DEPTH (b) | LEGEND (c) | CLASSIFICATION OF MATERIALS (Description) (d) | % CORE RECOVERY (e) | BOX OR SAMPLE NO. (f) | REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)

Depth scale: 10, 20, 30, 40

Classification of materials:

0.0 TO 2.2
SANDSTONE, SOFT, FLAGGY, FINE-MED GRN, BROWN & GRAY

2.2 TO 4.5
SHALE, SOFT, SLI WEATH, VERY SANDY, NON-CALC, DARK GRAY, SCAT FINE SHELL FRAGMENTS

4.5 TO 8.4
SHALE, UNWEATH, SOFT, MOIST, DARK GRAY W/ THIN LT GRAY SANDY SEAMS, LIGNITIC

8.4 TO 12.4
SANDSTONE, SOFT, FINE TO MED GRAINED, WEAKLY TO MOD CEMENTED, NON-CALC, MASSIVE, GRAY

12.4 TO 45.6
SHALE, MOD SOFT, UNWEATH, DARK GRAY TO GRAY, NON-CALC, LIGNITIC TO 15', NUM THIN SAND LENSES SCATTERED THROUGHOUT

16.1 - 17.2 SANDSTONE, MOD HARD, GRAY

19.7 UNHEALED FRACTURE 45° <

20.1 - 20.3 SILTSTONE, HARD
23.8 - 23.9 " "
31.8 - 32.0 " "

25.0 - 25.8 CALCAREOUS ZONE, HARD, LT GRAY

% Core recovery / Box or sample no.:

Depth	% Core recovery	Box or sample no.
		A
		B
		C
6.0		D
	100	1 — Box 1
10.0	L-.6'	2 — Box 2
14.0	100	
18.0	L-.2'	3 — Box 3
22.0	G-.3'	4 — Box 4
26.0	100	
30.0	L-.3'	5 — Box 5
34.0	G-.2'	Box 6
38.0	G-.4'	6

Remarks:

DRILLING

0.0 TO 6.0
8" AUGER

6.0 TO 108.5 TD
6" CORE BBL

SAMPLES

JAR A 0.0 - 0.3
B 0.3 - 2.2
C 2.2 - 4.5
D 4.5 - 6.0

CARTONS

1	6.0 - 6.9
2	11.5 - 12.4
3	17.5 - 18.4
4	22.1 - 23.0
5	29.5 - 30.4
6	37.5 - 38.4
7	41.9 - 42.8
8	46.7 - 47.6
9	51.0 - 51.9
10	56.5 - 57.4
11	63.5 - 64.4
12	68.5 - 69.4
13	72.8 - 74.7
14	79.0 - 79.9
15	84.2 - 85.1
16	92.0 - 92.9
17	98.3 - 99.2
18	103.6 - 104.5
19	105.2 - 106.1

HOLE WAS E-LOGGED

WATER

BORING LEFT OPEN FOR FUTURE WL OBSERVATION
22 FEB 83 WL 33 FT BELOW SURFACE
BAIL-DOWN/RECOVERY TEST PERFORMED 23 FEB 8

DRILLING LOG

DIVISION	
1. PROJECT	GRAPEVINE LAKE
2. LOCATION (Coordinates or Station)	
3. DRILLING AGENCY	
4. HOLE NO. (As shown on drawing title and file number)	BA6C-603
5. NAME OF DRILLER	
6. DIRECTION OF HOLE	☐ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	

ELEVATION (a) | DEPTH (b) | LEGEND (c) | CLASSIFICATION OF MATERIALS (Description) (d)

Depth scale: 40, 50, 60, 70, 80

45.6 TO 52.9
SANDSTONE, SOFT TO MOD HARD, FINE GRAINED, MOD TO WELL CEM, MASSIVE, GRAY

52.9 TO 65.6
SHALE, VERY SANDY, VERY SILTY, SOFT TO MOD HARD, NON-CALC, MOD WELL CEM, NUM SANDSTONE/SILTSTONE LENSES SCAT THROUGHOUT, INCREASINGLY SILTY W/ DEPTH

65.6 TO 71.2
SANDSTONE, MOD HARD TO HARD, WELL CEM, MASSIVE, LT GREENISH GRAY, VERY FINE GRAINED

71.2 TO 89.5
SANDSTONE, VERY SILTY, SOFT TO MOD HARD, VERY FINE GRAINED, MOD WELL CEM, GRAY
73.1 - 73.9 SOFT, POORLY CEM
77.3 - 77.9 HARD, LT GREENISH-GRAY

5 6 7

SHEET 2 OF 3 SHEETS

10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
12. MANUFACTURER'S DESIGNATION OF DRILL
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER
16. DATE HOLE — STARTED — COMPLETED
17. ELEVATION TOP OF HOLE
18. TOTAL CORE RECOVERY FOR BORING
19. SIGNATURE OF INSPECTOR

MATERIALS	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS
	42.0	Box 7	
	L - 3'	7	
... PT TO MOD ... AINED, MOD MASSIVE,	46.0 / 100	Box 8	
	50.0		
	G - 1'	9 / Box 9	
...NDY, VERY ... MOD HARD, ... WELL CEM, ...NE/SILTSTONE THROUGHOUT SILTY W/	54.0 / L - 1'	10	
	58.0 / 100	Box 10	
	62.0 / L - 1'	Box 11 / 11	
...OD HARD TO ...M, MASSIVE, ...TY, VERY	66.0 / 100	Box 12 / 12	
	70.0 / G - 4'	Box	
...ERY SILTY, ...ED, VERY FINE WELL CEM,	74.0	13 / 13	
...T, POORLY CEM ...ED, LT GREEN	L - 3' / 78.0	Box 14	
	G - 5'	14	

DRILLING LOG

1. PROJECT GRAPEVINE LAKE
2. LOCATION
3. DRILLING AGENCY
4. HOLE NO. BAEC-602
5. NAME OF DRILLER
6. DIRECTION OF HOLE — VERTICAL — INCLINED
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE

SHEET 3 OF 3 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% CORE RECOVERY	BOX OR SAMPLE NO.
	80'		82.0 - 87.7 SHALE, ... CLAY ..., GRAY		Box 15
				G - 5'	Box 16
	90		87.5 to 93.9 SHALE, VERY SANDY, MOD HARD, DARK GRAY, LESS SANDY W/ DEPTH, GRADES INTO PURE SHALE AT 93'	L - 3'	Box 17
			93.9 to 96.0 SANDSTONE, MOD HARD, VERY FINE GRAINED, WELL CEMENTED, GRAY		Box 18
	100		96.0 to 100.9 SHALE, MOD SOFT, SANDY, LAMINATED, DARK GRAY	L - 9'	
			100.9 to 108.5 SANDSTONE, SOFT TO MOD HARD, VERY FINE GRAINED, WELL CEMENTED, GRAY	G - 13'	Box 19
			108.5 T.D.	L - 5'	
	110				

FOR LOCATION OF BORING SEE

A MARR	GRAPEVINE ...
A MARR	MODIFI... EMBANKMENT
M GREEN	LOG OF BO...
MEL GREEN	

5 6 7 8

FOR LOCATION OF BORING SEE PLATE 4

GRAPEVINE LAKE

DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

MODIFICATION OF EMBANKMENT AND SPILLWAY

LOG OF BORING 8A6C-603

DESIGNED BY A. MARR

DRAWN BY A. MARR

REVIEWED BY M. GREEN

MEL GREEN

DACW63-83-B-0052

DATE AUG 1983

DACW63-83-C-0160

PLATE 19

TO ACCOMPANY FINAL FOUNDATION REPORT

Hole No. 6A4C-606

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 4 SHEETS

1. PROJECT: GRAPEVINE DAM
2. LOCATION (Coordinates or Station): SPILLWAY REPAIR
3. DRILLING AGENCY: USCE
4. HOLE NO. (As shown on drawing title and file number): 6A4C-606
5. NAME OF DRILLER: WYATT
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 4.0
8. DEPTH DRILLED INTO ROCK: 96.6
9. TOTAL DEPTH OF HOLE: 100.6
10. SIZE AND TYPE OF BIT: 8" AUGER, 4" CORE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3 | UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: 21
15. ELEVATION GROUND WATER: 1
16. DATE HOLE: STARTED 4/22/83 | COMPLETED 4/29/83
17. ELEVATION TOP OF HOLE: —
18. TOTAL CORE RECOVERY FOR BORING: 97.4%
19. SIGNATURE OF INSPECTOR: R. P. Audette

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		2, 4 / 0.0 TO 2.0 CLAY, MEDIUM PLASTICITY, STIFF, MOIST, SANDY, TAN		A	1 IMMEDIATELY AFTER BAILING WATER LEVEL TAPED AT -85.0 FT
					B	
				4.0	C	-- 72 HOURS LATER WATER LEVEL TAPED AT -24.70 FT
			2.0 TO 3.0 CLAY, MEDIUM TO HIGH PLASTICITY, STIFF, MOIST, SANDY, GRAY.	1 / 3.0	1	
				9.0 / 8.0		
	10.0		3.0 TO 4.0 CLAY, LOW TO MEDIUM PLASTICITY, STIFF, MOIST, TAN TO GRAY. -- AUGER REFUSAL @ 4.0' AT TOP OF PRIMARY.	1 / 1.0	2	2 TAPS A: 0.0-2.0 B: 2.0-3.0 C: 3.0-4.0
				13.0		
			4.0 TO 8.0 SANDSTONE, DARK GRAY, VERY FINE GRAINED, COMPACT, MASSIVE, THINLY BEDDED, UNJOINTED, FRACTURED, SLIGHTLY WEATHERED TO UNWEATHERED, SOFT.	1 / 0.1	3	3 CARTONS NO CARTON SAMPLES (CORE WAXED TO DEPTH)
				17.3		
	20.0			1 / 0.6	4	4 DRILLING 0.0-4.0, 8" AUGER 4.0-100.6, 4" CORE
			8.0 TO 16.8 SHALE, DARK GRAY TO BROWN, SANDY, LAMINATED TO THINLY BEDDED, VERY LIGNITIC FROM 8.0'-12.4', AND FROM 16.2'-16.8', FISSILE, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	22.3	5	
				1 / 0.1		
				27.1	6	
	30.0		-- SHARP BASAL CONTACT @ 10° WITH UNDERLYING SANDSTONE	1 / 0.4	7	
				32.1		
			16.8 TO 19.1 SANDSTONE, LIGHT GRAY, VERY FINE GRAINED, COMPACT, THINLY BEDDED WITH SHALE STRINGERS DISSEMINATED THROUGHOUT, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	1 / 0.6	8	
				37.0		
	40.0			1 / 1.8	9	

Hole No.

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH

1. PROJECT: GRAPEVINE DAM
2. LOCATION (Coordinates or Station): SPILLWAY REPAIR
3. DRILLING AGENCY: USCE
4. HOLE NO. (As shown on drawing title and file number): 6A4C-606
5. NAME OF DRILLER: WYATT
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 4.0
8. DEPTH DRILLED INTO ROCK: 96.6
9. TOTAL DEPTH OF HOLE: 100.6
10. SIZE AND TYPE OF BIT: 8" AUGER,
11. DATUM FOR ELEVATION SHOWN
12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: 3
14. TOTAL NUMBER CORE BOXES: 21
15. ELEVATION GROUND WATER: 1
16. DATE HOLE: STARTED 4/22/83
17. ELEVATION TOP OF HOLE: —
18. TOTAL CORE RECOVERY FOR BORING
19. SIGNATURE OF INSPECTOR: R. P. Aud

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS g
	40.0		19.1 TO 19.5 SHALE, BROWN, VERY FINE GRAINED, SANDY, LAMINATED TO THINLY BEDDED, FISSILE, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	42.0		
				6 / 0.4	10	
				46.0		
				1 / 0.3	11	
	50.0		19.5 TO 19.8 SANDSTONE, TAN, FINE GRAINED, MASSIVE, WELL INDURATED, UNJOINTED, UNFRACTURED, UNWEATHERED, HARD.	50.0		
				1 / 0.8	12	
			19.8 TO 29.3 SHALE, BROWN, VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, FISSILE, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	55.0		
				1 / 1.3	13	
	60.0			62.0	14	
			29.3 TO 29.6 SANDSTONE, DARK GRAY, FINE GRAINED, COMPACT, MASSIVE, THINLY BEDDED WITH FLUVIAL CROSS BEDDING UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	1 / 0.3		
				64.0		
				6 / 1.0	15	
				67.4		
	70.0		29.6 TO 30.0 SANDSTONE, LIGHT GRAY, FINE GRAINED, MASSIVE, WELL INDURATED, UNJOINTED, UNFRACTURED, UNWEATHERED, HARD.	1 / 0.1	16	
				72.2		
				1 / 0.1	17	
				77.2		
	80.0				18	

5 6 7 8 9

Hole No. BA4C-606
SHEET 2 OF 4 SHEETS

Hole No. BA4C-606
SHEET 3 OF 4 SHEETS

DRILLING LOG — DIVISION: SOUTHWESTERN — INSTALLATION: FORT WORTH

1. PROJECT: GRAPEVINE DAM
2. LOCATION: SPILLWAY REPAIR
3. DRILLING AGENCY: USCE
4. HOLE NO.: BA4C-606
5. NAME OF DRILLER: WYATT
6. DIRECTION OF HOLE: VERTICAL
7. THICKNESS OF OVERBURDEN: 4.0
8. DEPTH DRILLED INTO ROCK: 96.6
9. TOTAL DEPTH OF HOLE: 100.6

10. SIZE AND TYPE OF BIT: 8" AUGER 4" CORE
12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500
13. 3 — 0
16. DATE HOLE: 4.22/83 — 4/29/83
18. TOTAL CORE RECOVERY FOR BORING: 97.4%
19. SIGNATURE OF INSPECTOR: R R Audette

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.
	80.0		30.0 TO 61.7		
			SHALE. BROWN. VERY FINE GRAINED. LAMINATED TO THINLY BEDDED. FISSILE. UNJOINTED. VISIBLE SLICKENSLIDE @ 53.4' UNFRACTURED. UNWEATHERED WITH FABRIC PRESERVED THROUGHOUT. WELL INDURATED SANDSTONE SEAM @ 59.3'-59.4' SOFT	82.7	19
				0.2	
				86.9	20
	90.0			0.2	
			61.7 TO 62.2	91.5	
			SANDSTONE. LIGHT GRAY. VERY FINE GRAINED. COMPACT THINLY BEDDED WITH SHALE STRINGERS THROUGHOUT. UNJOINTED. UNFRACTURED. UNWEATHERED. SOFT TO MODERATELY HARD IN SECTION	2.0	21
				94.8	
				96.8	22
				0.6	
			62.2 TO 69.6		
	100.0		SANDSTONE. DARK GRAY. FINE GRAINED TO MEDIUM GRAINED. COMPACT. THINLY BEDDED. UNWEATHERED. UNJOINTED. UNFRACTURED. SOFT.	102.4	
			69.6 TO 74.2		
	110.0		SHALE. DARK GRAY. VERY FINE GRAINED. LAMINATED TO THINLY BEDDED. SANDY FISSILE. UNWEATHERED. UNJOINTED. UNFRACTURED. SOFT.		
	120.0				

DRILLING LOG — SOUTHWESTERN — FORT WORTH

GRAPEVINE DAM
SPILLWAY REPAIR
USCE
BA4C-606
WYATT
4.0
96.6
100.6
FAILING

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)
	120.0		74.2 TO 84.2
			SANDSTONE, GRAY. VERY FINE GRAINED. COMPACT. THINLY BEDDED. UNFRACTURED. UNWEATHERED THROUGHOUT. UNJOINTED. ARGILLACEOUS WITH PROMINENT SHALE SEAMS @ 76.4'-76.6', 77.2'-77.4', 77.8'-77.9' SOFT TO MODERATELY HARD
	130.0		84.2 TO 100.6 (T.D.)
			SHALE, BROWN. VERY FINE GRAINED. LAMINATED TO THINLY BEDDED. FISSILE. UNJOINTED. UNFRACTURED. UNWEATHERED. SOFT
			STRUCTURAL FEATURES
	140.0		THE SHALE: SANDSTONE CONTACTS APPEAR TO BE RELATIVELY HORIZONTAL. BEDDING PLANES IN BOTH THE SHALE AND SANDSTONE HORIZONS APPEAR TO BE FLAT WITH SOME FLUVIAL CROSS BEDDING WITHIN THE SANDSTONES. THE ENTIRE SEQUENCE IS UNJOINTED
			T.D. 100.6'
	150.0		
	160.0		

FOR LOCATION OF BORING SEE PLATE 4

2

DESIGNED BY: A. MARR
DRAWN BY: A. MARR
CHECKED BY: M. GREEN
MEL GREEN

GRAP
DENTON CREEK, ELM
MODIF
EMBANKMEN
LOG OF B

5 6 7 8

8 9 10

HOLE NO. 8A4C-606

8 4 NR X CORE

4/29/83

97.4%

R. Audette

DRILLING LOG	SOUTHWESTERN	FORT WORTH	SHEET 4 OF 4 SHEETS
GRAPEVINE DAM SPILLWAY REPAIR USCE		8" AUGER, 4" CORE	
8A4C-606		FAILING 1500	
WYATT		3	0
		21	
		4/22/83	4/29/83
4.0			
96.6		97.4%	
100.6		R R Audette	

Elevation	Depth	Classification of materials
	120.0	74.2 TO 84.2 SANDSTONE, GRAY VERY FINE GRAINED COMPACT THINLY BEDDED UNFRACTURED UNWEATHERED THROUGHOUT, UNJOINTED. ARGILLACEOUS WITH PROMINENT SHALE SEAMS 75.4'-76.6', 77.2'-77.4', 77.8'-77.9'. SOFT TO MODERATELY HARD
	130.0	84.2 TO 100.6' (TD) SHALE, BROWN, VERY FINE GRAINED LAMINATED TO THINLY BEDDED FISSILE UNJOINTED UNFRACTURED UNWEATHERED. SOFT
		STRUCTURAL FEATURES
	140.0	THE SHALE/SANDSTONE CONTACTS APPEAR TO BE RELATIVELY HORIZONTAL BEDDING PLANES IN BOTH THE SHALE AND SANDSTONE HORIZONS APPEAR TO BE FLAT WITH SOME FLUVIAL CROSS BEDDING WITHIN THE SANDSTONES THE ENTIRE SEQUENCE IS UNJOINTED TD 100.6'
	150.0	
	160.0	

LOCATION OF BORING SEE PLATE 4

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY A. MARR

DRAWN BY A. MARR

REVIEWED BY M. GREEN

MEL GREEN

GRAPEVINE LAKE

DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

MODIFICATION OF EMBANKMENT AND SPILLWAY

3

LOG OF BORING 8A4C-606

INVITATION NO. DACW63-83-B-0052 | DATE AUG 1983

CONTRACT NO. DACW63-83-C-0180

PLATE 20

DACW63-83-C-0180

7 8

TO ACCOMPANY FINAL FOUNDATION REPORT

1 2 3 4 5

F

E

D

C

B

A

Hole No BAHC-603

DRILLING LOG

DIVISION	SOUTHWESTERN
INSTALLATION	FORT WORTH
SHEET 1 OF 3 SHEETS	
1. PROJECT	GRAPEVINE DAM
2. LOCATION (Coordinates or Station)	SPILLWAY REPAIR
3. DRILLING AGENCY	USCE
4. HOLE NO. (As shown on drawing title and file number)	BA4C-607
5. NAME OF DRILLER	BEAVERS
6. DIRECTION OF HOLE	☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	4.0
8. DEPTH DRILLED INTO ROCK	81.0
9. TOTAL DEPTH OF HOLE	85.0
10. SIZE AND TYPE OF BIT	6" RIVER A/V ROCK BIT, 4" CORE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	8
15. ELEVATION GROUND WATER	**
16. DATE HOLE	STARTED 4/21/83 / COMPLETED 4/25/83
17. ELEVATION TOP OF HOLE	--
18. TOTAL CORE RECOVERY FOR BORING	97.6%
19. SIGNATURE OF INSPECTOR	R.R. Audette

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		0.0 TO 4.0 SAND, FINE GRAINED, LOOSE, MOIST, CLAYEY, BROWN		A	** 1. IMMEDIATELY AFTER BAILING WATER LEVEL TAPED AT - 83.5 FT. -- 24 HOURS LATER WATER LEVEL TAPED AT - 33.5 FT
			4.0 TO 49.6 SHALE/SANDSTONE INTERBEDDED SEQUENCES OF SOFT BROWN SHALE AND SOFT TO HARD LIGHT GRAY TO GRAY SANDSTONE. (SECTION LOGGED FROM ROCK BIT ACTION AND CUTTINGS).			2. JARS A: 0.0 - 4.0
	10.0		49.6 TO 59.9 SHALE, BROWN VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, FISSILE, LIGNITIC, UNWEATHERED WITH FABRIC PRESERVED THROUGHOUT, UNJOINTED, UNFRACTURED, SOFT.			3. CARTONS NO CARTON SAMPLES (CORE WAXED TO DEPTH) 4. DRILLING 0.0 - 4.0, AUGER REFUSAL 4.0 - 49.6, 6¼" ROCK BIT 49.6 - 85.0, 4" CORE
	20.0		59.9 TO 71.2 SANDSTONE, LIGHT GRAY TO GRAY, VERY FINE GRAINED, COMPACT, THINLY BEDDED, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.		ROCK BIT	
	30.0		71.2 TO 74.9 SHALE, DARK GRAY, VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, COMPACT, VERY SANDY, UNWEATHERED, UNJOINTED, UNFRACTURED, SOFT.			
	40.0					

DRILLING LOG

DIVISION	SOUTHWESTERN
1. PROJECT	GRAPEVINE DAM
2. LOCATION (Coordinates or Station)	SPILLWAY REPAIR
3. DRILLING AGENCY	USCE
4. HOLE NO. (As shown on drawing title and file number)	BA4C-607
5. NAME OF DRILLER	BEAVERS
6. DIRECTION OF HOLE	☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	4.0
8. DEPTH DRILLED INTO ROCK	81.0
9. TOTAL DEPTH OF HOLE	85.0

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d
	40.0		74.9 TO 78.5 SANDSTONE, LIGHT GRAY, VERY FINE GRAINED, COMPACT, WEAKLY CEMENTED, THINLY BEDDED WITH SHALE SEAMS 76.2'-76.4', AND FROM 78.0' TO 78.3', UNJOINTED, UNFRACTURED, SOFT.
	50.0		78.5 TO 80.3 SANDSTONE, BROWN, FINE GRAINED, WELL INDURATED, THINLY BEDDED WITH THIN SHALE SEAMS THROUGHOUT. THIN VERY SOFT GRAY SANDSTONE SEAM FROM 79.6' - 80.3', UNJOINTED, UNFRACTURED, UNWEATHERED, HARD.
			80.3 TO 81.5 SANDSTONE, LIGHT GRAY, VERY FINE GRAINED, MASSIVE, WEAKLY CEMENTED, THINLY BEDDED WITH SHALE LAMINAE THROUGHOUT, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.
	60.0		81.5 TO 82.7 SANDSTONE, BROWN, FINE GRAINED, WELL INDURATED, THINLY BEDDED WITH NUMEROUS SHALE LAMINAE THROUGHOUT, UNWEATHERED, UNJOINTED, UNFRACTURED, HARD.
	70.0		
	80.0		

1 2 3 4

5 6 7 8

Hole No. BA4C-607

INSTALLATION	FORT WORTH
SHEET	2 OF 3 SHEETS
SIZE AND TYPE OF BIT	8" PARKER 6¾" ROCK BIT, 4" CORE
MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
TOTAL NUMBER CORE BOXES	8
ELEVATION GROUND WATER	44
DATE HOLE	STARTED 4/21/83 / COMPLETED 4/25/83
TOTAL CORE RECOVERY FOR BORING	97.5%
SIGNATURE OF INSPECTOR	R.R. Audette

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	496		CEMENTED		ROCK BIT	
				100		
	520				1	
			SEAMS	102		
	545				2	
			UNJOINTED, UNWEATHERED	132		
	588			632		
	599				3	
				103		
	649				4	
				104		
	677				5	
				100		
	722				6	
				100	7	
	773					

Hole No. BA4C-607

DRILLING LOG	DIVISION SOUTHWESTERN
INSTALLATION	FORT WORTH
SHEET	3 OF 3 SHEETS
1. PROJECT	GRAPEVINE DAM SPILLWAY REPAIRS
3. DRILLING AGENCY	USCE
4. HOLE NO. (As shown on drawing title and file number)	BA4C-607
5. NAME OF DRILLER	BEAVERS
6. DIRECTION OF HOLE	☑ VERTICAL ☐ INCLINED
7. THICKNESS OF OVERBURDEN	42
8. DEPTH DRILLED INTO ROCK	815
9. TOTAL DEPTH OF HOLE	850
SIZE AND TYPE OF BIT	8" PARKER 6¾" ROCK BIT, 4" CORE
MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	1 / 0
TOTAL NUMBER CORE BOXES	8
ELEVATION GROUND WATER	44
DATE HOLE	STARTED 4/21/83 / COMPLETED 4/25/83
TOTAL CORE RECOVERY FOR BORING	97.6%
SIGNATURE OF INSPECTOR	R.R. Audette

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS
	800		BOX 7, 8-9			
			SANDSTONE, LIGHT GRAY TO GRAY, VERY FINE GRAINED, WEAKLY CEMENTED, THINLY BEDDED, UNJOINTED, UNWEATHERED, UNFRACTURED, SOFT		8	
				849		
			STRUCTURAL FEATURES			
	900		SHALE/SANDSTONE CONTACTS APPEAR TO BE HORIZONTAL BEDDING PLANES. BOTH THE SHALE AND SANDSTONE HORIZONS ARE LIGHT WITH ... CROSS BEDDING WITHIN THE SANDSTONES. THE ENTIRE SEQUENCE IS UNJOINTED AND UNFRACTURED			
			T.D. -849'			
	1000					
	1100					
	1200					

FOR LOCATION OF BORING SEE

A MARR

A MARR

M GREEN

MEL GREEN

GRAPEVINE

LOG OF B

2

5 6 7 8

HOLE No. 8A4C-607

FORT WORTH

8 A-SER 3" ROCK B T H E

FAILING 1500

4/21/83 4/25/83

R. R. Audette

FOR LOCATION OF BORING SEE PLATE 4

A. MARR

A. MARR

M. GREEN

MEL GREEN

GRAPEVINE LAKE

DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

MODIFICATION OF

EMBANKMENT AND SPILLWAY

3

LOG OF BORING 8A4C-607

DACW63-83-B-0052

DACW63-83-C-0160

AUG 1983

PLATE 21

DACW63-83-C-0160

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-82